Section B. Technical Notes

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SURVEY METHODOLOGY[1]

REPORTING UNIT

The reporting unit for the Survey of Industrial Research and Development is the company, defined as a business organization of one or more establishments under common ownership or control. The survey includes two groups of enterprises: (1) companies known to conduct R&D, and (2) a sample representation of companies for which information on the extent of R&D activity is uncertain.

FRAME CREATION

The Standard Statistical Establishment List, a Bureau of the Census compilation that contains information on more than 3 million establishments with paid employees, was the target population from which the frame used to select the 1997 survey sample was created (see table B-1 for target population and sample sizes). For companies with more than one establishment, data were summed to the company level. Each firm was then assigned a single SIC code based on the activity of the establishment having the highest dollar value of payroll. This assignment was done on a hierarchical basis. The enterprise was first assigned to the economic division (manufacturing or nonmanufacturing) with the highest payroll, then to the 2-digit SIC code with the highest payroll within the assigned division, then to the 3-digit SIC code with the highest payroll within the assigned 2-digit industry.

The frame from which the survey sample was drawn included all for-profit companies classified in nonfarm industries. For surveys prior to 1992, the frame was limited to companies above certain size criteria based on number of employees.[2] These criteria varied by industry. Some industries were excluded from the frame because it was believed that they contributed little or no R&D activity to the final survey estimates. For the 1992 sample, new industries were added to the frame,[3] and the size criteria were lowered considerably and applied uniformly to firms in all industries. As a result, nearly 2 million enterprises with 5 or more employees were given a chance of selection. For comparison, the frame for the 1987 sample included 154,000 companies of specified sizes and industries. The frame used to select the 1997 sample was similar to those used to select the 1992–96 samples.

DEFINING SAMPLING STRATA

A fundamental change initiated in 1995 and repeated for the 1996 and 1997 samples was the redefinition of the sampling strata. For the survey years 1992–94, 165 sampling strata were established, each stratum corresponding to one or more 3-digit-level SIC codes. The objective was to select sufficient representation of industries to determine whether alternative or expanded publication levels were warranted. For the 1997 survey, the strata were defined to correspond to publication-level industry aggregations, and companies were assigned to strata based on their 3-digit SIC codes. A total of 40 such levels were defined, corresponding to the original 25 groupings of manufacturing industries used as strata in sample designs before 1992 and to 15 new groupings of nonmanufacturing industries.

IDENTIFYING CERTAINTY COMPANIES

The criteria for identifying companies selected with certainty for the survey have been modified since 1994. With a fixed total sample size, there was some concern that representation of the very large noncertainty universe by a smaller sample each year would be inadequate. Before 1994, companies with 1,000 or more employees had been selected with certainty, but it was observed that the level of spending varied considerably and that many of these companies reported no R&D expenditures each year. Beginning in 1995, these companies were thus given chances of selection based only upon the size of their R&D spending if they were in the previous survey or upon an estimated R&D value if they were not. To further limit the growth in the number of certainty cases occurring each year, the certainty criterion—the size of their R&D spending—was raised for the 1996 survey from $1 million to $5 million; it remained at that level for the 1997 survey.

[1] Information for this section was provided by the Manufacturing and Construction Division of the U.S. Bureau of Census, which collected and compiled these survey data for NSF. Copies of the technical papers cited can be obtained from NSF's Research and Development Statistics Program in the Division of Science Resources Studies.

[2] See U.S. Bureau of Census (1994d).

[3] These industries are listed and discussed later under "Comparability of Statistics."

Frame Partitioning

The partitioning of the frame into "large" and "small" company components and the use of simple random sampling (SRS) for the small company partition were first introduced in the 1994 survey. A study of 1992 survey results showed that a disproportionate number of small companies were being selected for the sample, often with very large weights. These small companies seldom reported R&D activity. This disproportion was a result of the minimum probability rule (discussed later) used as part of the independent probability proportionate to size (PPS) sampling procedure, which was the only procedure used prior to 1994. This rule increased the probability of selection for several hundred thousand of these smaller companies. With SRS, these smaller companies can be sampled more efficiently than with independent PPS sampling since there is little variability in their size.

For 1995, total company payroll was the basis for the split between large and small partitions. For each industry grouping, the largest companies representing the top 90 percent of the total payroll were included in the PPS frame. The balance of smaller companies comprising the remaining 10 percent of payroll for the industry grouping were included in the SRS frame. A benefit of this design change was a reduction in the maximum allowable weight for selected companies (weighting and maximum weights are discussed later).

For 1996 and 1997, total company employment was the basis for partitioning the frame. The total company employment levels defining the partitions were based on the relative contribution to total R&D expenditures of companies in different employment size groups in both the manufacturing and nonmanufacturing sectors. In the manufacturing sector, all companies with total employment of 50 or more were included in the large company partition. In the nonmanufacturing sector, all companies with total employment of 15 or more were included in the large company partition. Companies in the respective sectors with employment below these values were included in the small company partition. In the 1997 survey, the large company partition contained about 540,000 companies; the small company partition contained about 1.3 million companies. These counts were comparable to those in the 1995 (656,000 and 1.2 million, respectively) and 1996 (560,000 and 1.3 million, respectively) partitions.

Identifying "Zero" Industries

One final modification in frame development for 1996, which was repeated for 1997, was the designation of "zero industries" in the large company partition. Zero industries were those 3-digit SIC industries having no R&D expenditures reported in the survey years 1992–94—the years when estimates by 3-digit SIC industry were formed. It was decided to keep these industries in the scope of the survey but to draw only a limited sample from them, since it seemed unlikely that R&D expenditures would be reported. SRS was used to control the number of companies selected within these industries.

Sample Selection

A significant revision in the procedure for selecting samples from the partitions changed the development and presentation of estimates from the 1996 survey; this approach was repeated for the 1997 survey. A sample of companies in the large company partition was selected using PPS sampling in each of the 40 strata as in 1995. The sample of companies in the small company partition was selected using SRS in only 2 strata rather than 40 as in 1995. Companies classified in manufacturing industries were selected to represent the group of all manufacturing industries rather than each manufacturing industry group. Similarly, companies classified in nonmanufacturing industries were selected to represent the group of all nonmanufacturing industries.

The purpose of selecting small companies from only two strata was to reduce the variability in industry estimates attributed to the random year-to-year selection of the companies in an industry and the associated high sampling weights. Consequently, estimates for individual industry groups are not possible from these two strata.[4] Statistics for the detailed industry groups are based only on the sample from the large company partition. Estimates from the small company partition are included in statistics for total manufacturing, total nonmanufacturing, and all industries. For completeness, the estimates also are added to the categories "other manufacturing" and "other nonmanufacturing."

[4] However, estimates for companies in these groups *are* included with their less detailed 2-digit SIC classifications in one table (table A-2). In all other tables, they are added to the "other manufacturing" and "other nonmanufacturing" classifications.

Table B-1. Number of companies in the target population and selected for the sample, by industry: 1997

Industry	SIC code	Companies in target population	1997 survey			Companies reporting R&D expenditures for 1997 [3]		Companies reporting no R&D expenditures for 1997 [4]
			Companies selected for 1997 sample	Noncertainties [1]	Certainties [2]	Greater than or equal to $1 million	Less than $1 million	
All Industries		1,817,224	23,417	20,507	2,910	2,812	929	15,970
Manufacturing		189,759	4,655	3,230	1,425	1,618	506	1,906
Food, kindred, and tobacco products	20,21	2,583	159	97	62	72	25	54
Textiles and apparel	22,23	3,542	187	118	69	52	33	77
Lumber, wood products, and furniture	24,25	3,325	171	125	46	32	36	84
Paper and allied products	26	1,190	97	56	41	46	9	32
Chemicals and allied products	28	1,241	248	83	165	185	19	20
Industrial chemicals	281-82,286	304	72	14	58	64	2	3
Drugs and medicines	283	274	53	4	49	49	3	1
Other chemicals	284 85,287 89	663	123	65	58	72	14	16
Petroleum refining and extraction	13,29	2,000	56	38	18	21	0	29
Rubber products	30	2,620	281	174	107	109	55	77
Stone, clay, and glass products	32	1,241	64	37	27	33	5	22
Primary metals	33	1,247	98	46	52	60	12	22
Ferrous metals and products	331 32,3398 99	658	41	20	21	26	6	9
Nonferrous metals and products	333 36	589	57	26	31	34	6	13
Fabricated metal products	34	4,604	407	284	123	124	82	144
Machinery	35	4,684	335	164	171	238	33	39
Office, computing, and accounting machines	357	4,381	273	156	117	56	1	1
Other machinery, except electrical	351 56,358 59	303	62	8	54	182	32	38
Electrical equipment	36	2,827	361	127	234	279	32	20
Radio and TV receiving equipment	365	103	20	4	16	15	2	0
Communication equipment	366	361	82	14	68	73	4	2
Electronic components	367	1,243	134	42	92	105	13	6
Other electrical equipment	361 64,369	1,120	125	67	58	86	13	12
Transportation equipment	37	1,438	84	21	63	61	6	9
Motor vehicles and motor vehicles equipment	371	752	41	12	29	28	6	4
Other transportation equipment	373 75,379	448	15	6	9	9	0	2
Aircraft and missiles	372,376	238	28	3	25	24	0	3

See explanatory information and SOURCE at end of table.

Table B-1. Number of companies in the target population and selected for the sample, by industry: 1997

Industry	SIC code	Companies in target population	1997 survey			Companies reporting R&D expenditures for 1997 [3]		Companies reporting no R&D expenditures for 1997 [4]
			Companies selected for 1997 sample	Noncertainties [1]	Certainties [2]	Greater than or equal to $1 million	Less than $1 million	
Professional and scientific instruments	38	1,340	342	182	160	235	37	22
Scientific and mechanical measuring instruments	381 82	687	203	114	89	139	30	10
Optical, surgical, photographic, and other instruments	384 87	653	139	68	71	96	7	12
Other manufacturing industries [5]	27,31,39	155,877	1,765	1,678	87	71	122	1,255
Nonmanufacturing		1,627,465	18,762	17,277	1,485	1,194	423	14,064
Transportation and utilities	40 42,44 49	29,003	896	731	165	71	35	648
Communications	48	3,696	320	233	87	17	9	236
Telephone communications	481	1,135	32	21	11	9	1	19
Other communications	482 484,489	2,561	288	212	76	8	8	217
Electric, gas, and sanitary services	49	1,420	121	59	62	40	21	48
Other transportation and utilities	40 42,44 47	23,887	455	439	16	14	5	364
Trade	50 59	231,574	4,736	4,629	107	122	70	3,729
Finance, insurance, and real estate	60 65,67	36,230	835	764	71	42	8	669
Services	701,72,73,75 81, 83,84,87,89	171,420	6,022	4,946	1,076	928	249	3,947
Business services	73	41,166	1,508	1,164	344	396	67	785
Computer and data processing services	737	7,972	763	466	297	371	52	209
Other business services	731 736,738	33,194	745	698	47	25	15	576
Health services	80	37,361	827	785	42	17	16	674
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	19,191	476	440	36	11	15	385
Other health services	802 805,808 809	18,170	351	345	6	6	1	289

See explanatory information and SOURCE at end of table.

Table B-1. Number of companies in the target population and selected for the sample, by industry: 1997

Industry	SIC code	Companies in target population	1997 survey			Companies reporting R&D expenditures for 1997 [3]		Companies reporting no R&D expenditures for 1997 [4]
			Companies selected for 1997 sample	Noncertainties [1]	Certainties [2]	Greater than or equal to $1 million	Less than $1 million	
Engineering and management services	87	22,979	2,440	1,772	668	499	155	1,498
Engineering, architectural, and surveying	871	8,694	1,235	923	312	155	110	849
Research, development, and testing	873	2,831	722	419	303	328	34	258
Other engineering and management services	872,874	11,454	483	430	53	16	11	391
Other services	701,72,75 79,81, 83,84,89	69,914	1,247	1,225	22	16	11	990
Other nonmanufacturing industries [5]	07 12,14,15, 161 162,17	1,159,238	6,273	6,207	66	31	61	5,071

[1] Non-certainties are companies whose probability of selection is less than one.

[2] Certainties are companies whose probability of selection is one. This includes companies whose 1996 R&D expenditures are equal to or greater than $5 million.

[3] This includes R&D-1L companies for which total R&D expenditure data were imputed.

[4] Does not include companies that did not respond to the survey or that did not indicate any information about R&D performance on a returned questionnaire.

[5] Beginning in 1996, manufacturing companies with fewer than 50 employees and nonmanufacturing companies with fewer than 15 employees were sampled separately without regard to industry classification to minimize year-to-year variation in survey estimates. Estimates for manufacturing companies in this group are combined with those for companies in "Other manufacturing industries." Estimates for nonmanufacturing companies in this group are combined with those for companies in "Other nonmanufacturing industries." As a result, statistics for "Other manufacturing industries" and for "Other nonmanufacturing industries" after 1995 are not comparable with statistics for prior years.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1997

Probability Proportionate to Size

For 1995, the distribution of companies by payroll and estimated R&D in the large partition of the sample was skewed as in earlier frames. Because of this skewness, PPS sampling used in previous designs was an appropriate selection technique for this group. That is, large companies had a higher probability of selection than did small companies. It would have been ideal if company size could have been determined by its R&D expenditures. Unfortunately, except for the companies that were in a previous survey or for which there was information from external sources, it was impossible to know the R&D expenditures for every firm in the universe. Consequently, the probability of selection for most companies was based on estimated R&D expenditures.

Imputing R&D. Since total payroll was known for each company in the universe, it was possible for the 1997 survey to estimate R&D from payroll using relationships derived from 1996 survey data. Imputation factors relating these two variables were made for each industry grouping. To impute R&D for a given company, the imputation factors were applied to the company payroll in each industry grouping. A final measure was obtained by adding the industry grouping components. The effect, in general, was to give firms with large payrolls higher probabilities of selection in accordance with the assumption that larger companies were more likely to perform R&D.

Estimated R&D values were computed for companies in the small company partition as well. The aggregate of reported and estimated R&D from each company in both the large and small company partitions represented a total universe measure of 1996 R&D expenditures. However, assigning a value for R&D to every company resulted in an overstatement of this measure. To adjust for the overstatement, the universe measure for the 1997 survey was scaled down using factors developed from the relationship of the frame measure of 1996 R&D and the 1996 survey estimate. These factors, computed at levels corresponding to published industry levels, were used to adjust originally imputed R&D values so that the new frame total for R&D at these levels approximated the 1996 published values. This adjustment provided for better allocation of the sample among these levels.

Simple Random Sampling

Only two major strata were defined for samples in the small company partition—manufacturing and nonmanufacturing. The use of SRS implied that each company within a stratum had an equal probability of selection. The total sample allocated to the small company partition was dependent upon the total sample specified for the survey and upon the total sample necessary to satisfy criteria established for the large company partition. Once determined, the allocation of this total by stratum was made proportionate to the stratum's payroll contribution to the entire partition.

Sample Stratification and Relative Standard Error Constraints

The particular sample selected for each survey year was one of a large number of the same type and size that by chance might have been selected. Statistics resulting from the different samples would differ somewhat from each other. These differences are represented by estimates of sampling error. The smaller the sampling error, the more precise the statistic.

Controlling Sampling Error. The large company partition was of primary concern, since it was believed that nearly all of the R&D activity would be identified from this sector. To control sampling error in the statistics resulting from this portion of the frame, parameters were specified to allocate the sample across various levels, or strata, that corresponded to the 40 industry groupings discussed earlier. These parameters determined the sample size required to achieve a desired level of sampling error for each stratum and were assigned so that estimated errors of total R&D expenditures for industries in these strata did not exceed certain levels. Sample sizes among the strata were constrained only by the limit placed on the total sample size dictated by the available budget.

Sampling Strata and Standard Error Estimates. The practice, first implemented in the 1995 survey and continued in the 1996 and 1997 surveys, of establishing sampling strata corresponding to published industry groupings meant that more efficient samples could be selected for these groups than had resulted when using the 165-strata design. Even the expansion of the number of nonmanufacturing publication groupings resulted in fewer sampling strata. The earlier designs defined 25 strata of 3-digit-SIC manufacturing industries, but published only one category of nonmanufacturing industry. Beginning with the 1995 sample design, 15 nonmanufacturing strata were defined for sampling and publication levels. Since there was no mandate in any ensuing year to make a major reduction in the sample of 17,600 companies for the large company partition selected under the 165-strata design, it was possible to establish much

tighter relative standard error constraints on the smaller number of sampling strata. Thus, in 1997, 33 strata were assigned a relative standard error constraint of 1 percent, while 7 strata were assigned a relative standard error constraint of 0.5 percent. These constraints resulted in an expected sample size of about 8,276 companies from the large company partition. The minimum probability rule (discussed later) was adjusted so as to raise the expected sample size closer to the 17,000 level.

A limitation of the sample allocation process for the large partition should be noted. The sampling errors used to control the sample size in each stratum are based on a universe total that, in large part, was improvised. That is, as previously noted, an R&D value was assigned to every company in the frame, even though most of these companies actually may not have had R&D expenditures. The value assigned was imputed for the majority of companies in the frame, and—as a consequence—the estimated universe total and the distribution of individual company values, even after scaling, did not necessarily reflect the true distribution. Estimates of sampling variability were nevertheless based on this distribution. The presumption was that actual variation in the sample design would be less than that estimated, because many of the sampled companies have true R&D values of zero, not the widely varying values that were imputed using total payroll as a predictor of R&D. Previous sample selections indicate that in general this presumption holds, but exceptions have occurred when companies with large sampling weights have reported large amounts of R&D spending. Thus, in general, the 1 percent and 0.5 percent error levels described earlier are conservative. See table B-2 for the actual standard error estimates for selected items by industry.

For the 1995 small company partition, 40 strata were identified. Also included was a separate stratum of approximately 6,260 companies that could not be classified into an SIC code and therefore could not be assigned to a stratum because of incomplete industry identification in the Standard Statistical Establishment List. As was done for 1994, a small number of companies was selected from this group in the hopes that an accurate industry identification could be obtained at a later point. The initial sample size specified for the small company partition was 5,500 companies. The sample initially allocated to a given stratum was proportionate to its share of total payroll for the small partition. For the 1996 and 1997 small company partitions, two strata (manufacturing and nonmanufacturing) were identified, and a small number of companies was selected from the group of unclassifiable companies. For 1997, a final sample of 6,445 companies was selected from the small company partition. The sample initially allocated to the two strata was proportionate to its share of total payroll for the small company partition.

Nonsampling Error. In addition to sampling error, estimates are subject to nonsampling error. Errors are grouped in five categories: specification, coverage, response, nonresponse, and processing. For detailed discussions on the sources, control, and measurement of each of these types of error, see U.S. Bureau of the Census (1994b and 1994f).

Sample Size

The target sample size initially specified for the 1997 survey was 25,000 companies and, as described above, was based primarily on compliance with predetermined sampling error constraints established for the large partition. The actual sample size was 23,417 companies. The sample differed from the target for several reasons.

Independent Sampling. First, the frame for the large company partition was subjected to independent sampling. Each company in the frame had an independent chance of selection based on its assigned probability—i.e., selection of a company was completely independent of the selection of any other company. In independent (or Poisson) sampling, sample size itself is a random variable, and the actual sample size will vary around the target or "expected" sample size. Theoretically, a sample of size zero or a sample the size of the entire universe is possible, but the probabilities of these extremes are so small that these are improbable situations. In strata where the expected sample size is more than 50, the actual sample probably will be within a fairly narrow range so that increased variability is not a real problem. However, in strata where the expected sample is small (i.e., less than 10), gross over- or undersampling of the strata is possible. In practice, the size of the originally drawn sample is usually quite close to the specified size. If there is too much deviation, however, the selection can be repeated until it is closer to the target.

Minimum Probability Rule. Second, a minimum probability rule was imposed for both partitions in the sample. As noted earlier, for the large company partition, probabilities of selection proportionate to size were assigned each company, where size is the reported or imputed R&D value assigned to each company. Selected

Table B-2. Relative standard error for selected estimates, by industry and size of company: 1997

Industry and size of company	SIC code	Number of R&D-performing companies	Domestic net sales of R&D performers	Domestic employment of R&D performers	Number of FTE scientists and engineers	Total R&D	Company and other funds for R&D	Company-financed R&D performed outside of U.S.	Company-financed R&D contracted to outside organizations	Federal funds for R&D	Total funds for basic research	Total funds for applied research	Total funds for development
			[Percent]										
All Industries		3,741	3.6	8.8	1.4	1.0	1.2	0.4	4.3	1.0	5.5	3.2	1.1
Distribution by industry:													
Manufacturing		2,124	2.2	1.7	1.1	0.7	0.9	0.3	2.4	0.8	1.6	2.8	0.9
Food, kindred, and tobacco products	20,21	97	5.5	10.8	8.7	7.0	7.0	0.5	4.6	0.0	38.1	3.2	10.7
Textiles and apparel	22,23	85	5.7	5.9	8.4	2.6	2.7	0.4	41.2	0.0	20.9	11.7	2.3
Lumber, wood products, and furniture	24,25	68	8.5	8.8	19.0	10.9	10.9	0.0	1.1	0.0	8.3	5.0	13.7
Paper and allied products	26	55	2.1	2.6	2.0	1.2	1.2	0.0	8.5	0.0	0.2	3.3	5.6
Chemicals and allied products	28	204	1.8	1.8	0.9	0.5	0.5	0.0	0.2	0.0	1.3	1.2	0.5
Industrial chemicals	281-82,286	66	3.5	2.6	2.2	0.8	0.9	0.0	2.4	0.0	4.7	1.4	0.6
Drugs and medicines	283	52	1.7	3.7	0.8	0.5	0.5	0.0	0.3	0.0	0.0	2.0	0.2
Other chemicals	284-85, 287-89	86	3.5	2.8	2.0	2.5	2.5	0.0	0.2	0.0	13.8	1.3	4.1
Petroleum refining and extraction	13,29	21	16.3	4.9	1.0	0.5	0.5	0.0	0.0	0.0	0.0	0.8	1.0
Rubber products	30	164	24.8	4.6	10.5	2.5	2.5	2.4	1.1	0.0	5.0	7.9	3.4
Stone, clay, and glass products	32	38	3.4	4.4	4.0	0.8	0.8	0.4	0.0	0.0	6.1	0.3	1.0
Primary metals	33	72	14.1	13.7	11.4	12.9	13.9	2.7	3.6	10.2	20.5	2.7	30.3
Ferrous metals and products	331-32, 3398-99	32	13.3	20.7	18.0	20.2	25.7	0.0	7.9	10.5	0.0	2.3	43.2
Nonferrous metals and products	333-36	40	26.5	13.7	6.5	2.8	2.9	4.4	0.0	0.0	22.9	5.0	5.9
Fabricated metal products	34	206	3.6	4.2	10.8	9.2	6.1	0.6	30.3	64.7	26.9	46.8	8.6

See explanatory information and SOURCE at end of table.

Table B-2. Relative standard error for selected estimates, by industry and size of company: 1997

Industry and size of company	SIC code	Number of R&D-performing companies	Domestic net sales of R&D performers	Domestic employment of R&D performers	Number of FTE scientists and engineers	Total R&D	Company and other funds for R&D	Company-financed R&D performed outside of U.S.	Company-financed R&D contracted to outside organizations	Federal funds for R&D	Total funds for basic research	Total funds for applied research	Total funds for development
			[Percent]										
Distribution by industry:													
Machinery	35	271	3.8	3.7	3.8	3.1	3.1	1.8	13.8	2.7	11.6	12.9	3.5
Office, computing, and accounting machines	357	57	6.8	3.8	5.9	4.0	4.0	0.0	0.0	0.0	0.0	16.0	4.8
Other machinery, except electrical	351-56, 358-59	214	4.3	5.0	3.5	4.5	4.5	5.2	29.4	5.4	17.6	15.7	5.1
Electrical equipment	36	311	4.6	4.6	2.4	2.0	2.1	1.6	13.2	3.2	4.4	3.3	3.0
Radio and TV receiving equipment	365	17	1.3	3.6	0.5	0.9	0.9	0.0	0.0	0.0	0.0	7.6	0.6
Communication equipment	366	77	19.2	17.0	4.8	4.9	5.4	3.9	26.9	0.5	3.3	12.4	4.6
Electronic components	367	118	3.1	5.1	3.1	2.2	2.3	0.3	38.1	1.3	10.9	2.1	7.2
Other electrical equipment	361-64,369	99	1.8	3.6	3.9	2.2	2.0	2.0	1.4	12.3	6.4	4.5	2.9
Transportation equipment	37	67	2.6	2.5	0.8	0.3	0.6	0.0	0.4	0.0	0.1	0.6	0.4
Motor vehicles and motor vehicles equipment	371	34	3.8	4.4	1.9	0.7	0.8	0.0	0.4	0.0	0.6	1.9	0.8
Other transportation equipment	373-75,379	9	2.5	7.6	0.0	1.3	2.7	0.0	0.0	0.0	0.0	0.0	2.6
Aircraft and missiles	372,376	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Professional and scientific instruments	38	272	1.3	1.4	1.4	0.7	1.1	0.3	21.0	0.2	3.1	5.3	0.7
Scientific and mechanical measuring instruments	381-82	169	1.7	1.8	1.5	1.0	2.1	0.9	26.4	0.2	5.7	14.3	1.1
Optical, surgical, photographic, and other instruments	384-87	103	2.0	2.3	2.7	1.1	1.1	0.3	27.5	8.6	3.7	3.4	0.9
Other manufacturing industries [1]	27,31,39	193	9.3	6.9	12.3	14.0	13.7	0.0	63.8	79.5	24.8	20.9	17.9

See explanatory information and SOURCE at end of table.

Table B-2. Relative standard error for selected estimates, by industry and size of company: 1997

Industry and size of company	SIC code	Number of R&D-performing companies	Domestic net sales of R&D performers	Domestic employment of R&D performers	Number of FTE scientists and engineers	Total R&D	Company and other funds for R&D	Company-financed R&D performed outside of U.S.	Company-financed R&D contracted to outside organizations	Federal funds for R&D	Total funds for basic research	Total funds for applied research	Total funds for development
			[Percent]										
Distribution by industry:													
Nonmanufacturing		1,617	10.1	20.7	4.2	3.6	4.1	3.0	12.7	4.0	16.0	8.8	3.6
Transportation and utilities	40-42,44-49	106	22.1	43.8	29.7	14.9	16.0	0.0	14.9	0.0	0.9	29.2	10.6
Communications	48	26	24.8	27.2	1.2	0.3	0.3	0.0	1.4	0.0	0.7	0.0	0.4
Telephone communications	481	10	25.5	28.8	0.6	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0
Other communications	482-484,489	16	1.4	0.8	14.9	9.9	9.9	0.0	0.0	0.0	6.7	0.0	18.7
Electric, gas, and sanitary services	49	61	9.6	6.3	7.9	3.3	3.6	0.0	8.3	0.0	7.8	1.0	5.3
Other transportation and utilities	40-42,44-47	19	65.7	73.1	79.8	65.6	66.9	0.0	89.3	0.0	15.0	94.1	84.0
Trade	50-59	192	9.7	15.5	11.4	12.9	13.0	6.0	63.0	2.0	46.9	28.5	12.4
Finance, insurance, and real estate	60-65,67	50	3.9	6.2	28.3	20.0	20.0	0.0	17.2	0.0	26.4	38.1	20.4
Services	701,72,73, 75-81,83,84, 87,89	1,177	3.5	5.0	3.1	2.3	2.6	2.6	4.0	4.0	9.4	4.7	2.9
Business services	73	463	2.7	3.0	4.3	3.4	3.4	3.0	8.1	27.5	23.8	8.5	3.4
Computer and data processing services	737	423	2.9	3.2	4.3	3.5	3.5	3.0	8.2	28.3	24.1	8.7	3.5
Other business services	731-736,738	40	6.5	4.4	14.7	4.7	4.9	0.0	57.1	0.0	48.1	10.8	5.3
Health services	80	33	10.1	14.7	8.7	2.7	2.5	0.0	0.0	67.9	35.1	4.7	0.3
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	26	10.8	16.3	8.2	2.4	2.1	0.0	0.0	89.7	41.1	5.2	0.3
Other health services	802-805, 808-809	7	18.6	19.5	35.9	20.3	20.8	0.0	0.0	0.0	0.0	0.0	0.0

See explanatory information and SOURCE at end of table.

Table B-2. Relative standard error for selected estimates, by industry and size of company: 1997

Industry and size of company	SIC code	Number of R&D-performing companies	Domestic net sales of R&D performers	Domestic employment of R&D performers	Number of FTE scientists and engineers	Total R&D	Company and other funds for R&D	Company-financed R&D performed outside of U.S.	Company-financed R&D contracted to outside organizations	Federal funds for R&D	Total funds for basic research	Total funds for applied research	Total funds for development
			[Percent]										
Distribution by industry:													
Engineering and management services	87	654	1.6	2.1	3.4	2.6	3.6	4.5	6.4	3.2	6.0	6.2	3.4
Engineering, architectural, and surveying	871	265	1.5	2.1	5.0	6.3	10.7	0.0	5.5	7.2	17.2	8.9	7.5
Research, development, and testing	873	362	2.1	2.4	3.8	2.1	2.7	4.2	6.5	2.7	5.9	3.9	3.6
Other engineering and management services	872,874	27	5.5	7.0	20.3	40.2	42.0	71.7	0.0	0.0	6.9	75.3	21.9
Other services	701,72,75-79, 81,83,84,89	27	16.0	32.3	47.6	46.0	46.7	0.0	0.0	29.3	16.5	0.0	49.3
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	92	4.8	7.0	25.2	22.3	23.0	60.9	59.5	69.4	35.9	26.6	26.7

See explanatory information and SOURCE at end of table.

Table B-2. Relative standard error for selected estimates, by industry and size of company: 1997

Industry and size of company	SIC code	Number of R&D-performing companies	Domestic net sales of R&D performers	Domestic employment of R&D performers	Number of FTE scientists and engineers	Total R&D	Company and other funds for R&D	Company-financed R&D performed outside of U.S.	Company-financed R&D contracted to outside organizations	Federal funds for R&D	Total funds for basic research	Total funds for applied research	Total funds for development
			[Percent]										
Distribution by size of company: [Number of employees]													
Total		3,741	3.6	8.8	1.4	1.0	1.2	0.4	4.3	1.0	5.5	3.2	1.1
Fewer than 500		1,851	8.4	4.9	5.9	5.6	6.1	10.7	13.3	10.4	12.5	12.6	6.9
500 to 999		474	14.3	10.6	6.4	3.3	3.6	15.8	2.2	2.4	4.7	3.4	5.2
1,000 to 4,999		881	7.8	5.6	2.1	3.0	3.1	1.1	22.8	1.0	20.8	1.6	1.9
5,000 to 9,999		248	12.8	13.8	3.0	2.7	2.8	0.0	1.5	3.7	0.1	3.9	3.1
10,000 to 24,999		172	1.7	7.8	0.3	0.3	0.3	0.6	0.0	0.0	0.0	0.5	0.4
25,000 or more		115	6.8	18.8	1.3	0.6	0.8	0.0	2.9	0.0	0.0	3.7	0.4

[1] Beginning in 1996, manufacturing companies with fewer than 50 employees and nonmanufacturing companies with fewer than 15 employees were sampled separately without regard to industry classification to minimize year-to-year variation in survey estimates. Estimates for manufacturing companies in this group are combined with those for companies in "Other manufacturing industries." Estimates for nonmanufacturing companies in this group are combined with those for companies in "Other nonmanufacturing industries." As a result, statistics for "Other manufacturing industries" and for "Other nonmanufacturing industries" after 1995 are not comparable with statistics for prior years.

NOTE: A description of the standard error of estimate is given in section A under "Survey Methodology." The percentage (or relative) standard errors in this table may be converted to standard errors of estimate by multiplying the percentages shown by the associated estimates. For example, the relative standard error of estimate for R&D performance for all company size groups in the stone, clay, and glass products industry (SIC 32) is shown as 0.8 percent, and the associated total R&D estimate for this industry is shown as $608 million in Table A-3, "Total (company, Federal, and other) funds for industrial R&D performance, by industry and size of company: 1987 97." The standard error of estimate, then, is 0.008 times 608 or 4.9.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1997

companies received a sample weight that was the inverse of their probability of selection. Selected companies that ultimately report R&D expenditures vastly larger than their assigned values can have adverse effects on the statistics, which are based on the weighted value of survey responses. To lessen the effects on the final statistics, the maximum weight of a company was controlled by specifying a minimum probability that could be assigned to the company. If the probability based on company size was less than the minimum probability, it was reset to this minimum value. The consequence of raising these original probabilities to the minimum probability was to raise the expected sample size. Similarly, a maximum weight for each stratum was established for the SRS of the small partition. If the sample size initially allocated to a stratum resulted in a stratum weight above this maximum value, then the sample size was increased until the maximum weight was achieved. It is likely that most of the difference between the size of the target sample and the sample actually selected was due to the minimum probability rule.

Changes in Operational Status. Third, between the time the frame was created and the survey was prepared for mailing, the operational status of some companies changed. That is, they were merged with or acquired by another company, or they were no longer in business. Before preparing the survey for mailing, the operational status was updated to identify these changes. As a result, the number of companies mailed a survey form was somewhat smaller than the number of companies initially selected for the survey.

Weighting and Maximum Weights

Weights were applied to each company record to produce national estimates. Within the PPS partitions of the sample, company records were given weights up to a maximum of 50; for companies within the SRS partitions, company records were given weights up to a maximum of 250.

Survey Questionnaires

Two questionnaires are used each year to collect data for the survey: Form RD-1 in two versions for large firms, and Form RD-1A for small firms and first-time reporters. For large firms known to perform R&D, a detailed questionnaire, Form RD-1L, is used to collect data for odd-numbered years; an abbreviated version, Form RD-1S, is used to collect data for even-numbered years. The questionnaires are cycled in this manner to reduce the reporting burden on survey respondents.

Questionnaire Content

Form RD-1L, which was used for the 1997 survey, requests data on sales or receipts; total employment; employment of scientists and engineers; expenditures for R&D performed within the company with Federal funds and with company and other funds; character of work (basic research, applied research, and development); company-sponsored R&D expenditures in foreign countries; R&D performed under contract by others; expenditures for pollution abatement and energy R&D; detail on R&D by product field; Federal R&D support to the firm by contracting agency; domestic R&D expenditures by state; and foreign R&D by country. Form RD-1S requests the same information except the last four items. Because companies receiving Forms RD-1L and RD-1S generally have participated in previous surveys, computerized imprinted data reported by the company for the previous year are supplied for reference.

To further limit reporting burden on small R&D performers and firms that are included in the sample for the first time, an even more abbreviated form is used each year. Form RD-1A collects data only on R&D, sales, employment, and operational status and includes a screening item that allows respondents to indicate that they do not perform R&D before completing the questionnaire. No prior year information is available since the majority of the companies have not reported previously.

New Items. Beginning in 1996, the collection of data on R&D performed under contract by others was expanded. Previously, data were collected only on nonfederally funded R&D performed under contract by others. In 1996, data on contracted-out federally funded and total R&D were collected to better measure the amount of R&D performed both within and between companies.

Number of Questionnaires Sent

For the 1997 survey, approximately 2,900 companies, including those that reported $5 million or more in R&D expenditures in the 1996 survey, received Form RD-1L; and approximately 20,500 received Form RD-1A. Of the 23,400 firms, about 3,700 reported R&D expenditures for 1997. All three questionnaire forms and their accompanying instructions are reproduced in section C.

Follow-up for Survey Nonresponse

The 1997 survey questionnaires were mailed in March 1998, and recipients were asked to respond within 60 days. Thirty days later, letters were mailed to all survey recipients reminding them that their completed questionnaire was due within the next 30 days. After 60 days, follow-up letters were sent to all firms that did not respond. Three additional follow-up mailings were made to persistent nonrespondents after 90, 120, and 150 days.

In addition to the mailings, telephone follow-up was used to encourage response from those firms ranked among the 300 largest R&D performers, based on total R&D expenditures reported in the previous survey. Table B-3 shows the number of companies in each industry or industry group that received a questionnaire and the percentage of companies that responded to the survey.

Imputation for Item Nonresponse

For various reasons, many firms chose to return the survey questionnaires with one or more blank items.[5] For instance, the internal accounting procedures of the firm may not have allowed it to quantify the character of work distribution of R&D. In addition, some firms refused as a matter of policy to answer any voluntary questions.[6]

When respondents did not provide the requested information, estimates for the missing data were made using imputation algorithms. In general, the imputation algorithms computed values for missing items by applying the average percentage change for the target item in the nonresponding firm's industry to the item's prior year value for that firm, reported or imputed. This approach, with minor variation, was used for most items.[7] Table B-4 contains imputation rates for the principal survey items.

Response Rates and Mandatory Versus Voluntary Reporting

Current survey reporting requirements divide survey items into two groups: mandatory and voluntary. Response to four data items on the questionnaires is mandatory; response to the remaining items is voluntary. During the 1990 survey cycle, NSF conducted a test of the effect of reporting on a completely voluntary basis to determine if combining both mandatory and voluntary items on one questionnaire influences response rates. For this test, the 1990 sample was divided into two panels of approximately equal size. One panel—the mandatory panel—was asked to report as usual on four mandatory items with the remainder voluntary; the other panel was asked to report all items on a completely voluntary basis. The result of the test was a decrease in the overall survey response rate to 80 percent from levels of 88 percent in 1989 and 89 percent in 1988. The response rates for the mandatory and voluntary panels were 89 and 69 percent, respectively. Detailed results of the test were published in the annual report resulting from the 1990 survey.[8] For firms that reported R&D expenditures in 1997, table B-5 shows the percentage that also reported data for other selected items.

Character of Work Estimates

Response to questions about character of work (basic research, applied research, and development) declined in the mid-1980s, and, as a result, imputation rates increased. The general imputation procedure described above became increasingly dependent upon information imputed in prior years, thereby distancing current-year estimates from any reported information. Because of the increasing dependence on imputed data, NSF chose not to publish character of work estimates in 1986. The imputation procedure used to develop these estimates was revised in 1987 for use with later data and differs from the general imputation approach. The new method calculated the character of work distribution for a nonresponding firm only if that firm reported a distribution within a 5-year period, extending from 2 years before to 2 years after the year requiring imputation. Imputation for a given year was initially performed in the year the

[5] For detailed discussions on the sources, control, and measurement of error resulting from item nonresponse, see U.S. Bureau of the Census (1994b). For a general discussion of the problems stemming from item nonresponse, see NSF (1990).

[6] All but four items—total R&D, Federal R&D, net sales, and total employment, which are included in the Census Bureau's annual mandatory statistical program—are voluntary. See further discussion under "Response Rates and Mandatory Versus Voluntary Reporting" later.

[7] For detailed descriptions and analyses of the imputation methods and algorithms used, see U.S. Bureau of the Census (1994c).

[8] NSF, *Research and Development in Industry: 1990* (NSF 94-304), John R. Gawalt (Washington, DC, 1994).

Table B-3. Unit response rates percentage of companies that responded to survey, by industry: 1997

Industry	SIC code	Number of companies that received questionnaire	Response rate
All Industries		23,377	84.7%
Manufacturing		4,651	83.7
Food, kindred, and tobacco products	20,21	158	90.5
Textiles and apparel	22,23	188	84.6
Lumber, wood products, and furniture	24,25	170	88.2
Paper and allied products	26	96	88.5
Chemicals and allied products	28	247	83.4
Industrial chemicals	281-82,286	72	88.9
Drugs and medicines	283	53	86.8
Other chemicals	284-85,287-89	122	78.7
Petroleum refining and extraction	13,29	56	87.5
Rubber products	30	281	81.8
Stone, clay, and glass products	32	64	87.5
Primary metals	33	98	87.8
Ferrous metals and products	331-32,3398-99	41	92.7
Nonferrous metals and products	333-36	57	84.2
Fabricated metal products	34	406	83.7
Machinery	35	335	84.8
Office, computing, and accounting machines	357	62	80.6
Other machinery, except electrical	351-56,358-59	273	85.7
Electrical equipment	36	360	80.0
Radio and TV receiving equipment	365	20	70.0
Communication equipment	366	83	77.1
Electronic components	367	133	84.2
Other electrical equipment	361-64,369	124	79.0
Transportation equipment	37	83	86.7
Motor vehicles and motor vehicles equipment	371	41	92.7
Other transportation equipment	373-75,379	14	71.4
Aircraft and missiles	372,376	28	85.7
Professional and scientific instruments	38	340	80.6
Scientific and mechanical measuring instruments	381-82	202	83.7
Optical, surgical, photographic, and other instruments	384-87	138	76.1
Other manufacturing industries [1]	27,31,39	1,761	83.2

See explanatory information and SOURCE at end of table.

Table B-3. Unit response rates percentage of companies that responded to survey, by industry: 1997

Industry	SIC code	Number of companies that received questionnaire	Response rate
Nonmanufacturing		18,726	84.9%
Transportation and utilities	40-42,44-49	898	85.6
Communications	48	322	84.1
Telephone communications	481	33	90.9
Other communications	482-484,489	289	83.4
Electric, gas, and sanitary services	49	121	87.6
Other transportation and utilities	40-42,44-47	455	86.1
Trade	50-59	4,733	84.8
Finance, insurance, and real estate	60-65,67	835	86.8
Services	701,72,73,75-81, 83,84,87,89	6,011	84.8
Business services	73	1,505	80.5
Computer and data processing services	737	760	77.4
Other business services	731-736,738	745	83.8
Health services	80	826	87.0
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	473	88.4
Other health services	802-805,808-809	353	85.3
Engineering and management services	87	2,435	87.3
Engineering, architectural, and surveying	871	1,235	89.6
Research, development, and testing	873	717	82.7
Other engineering and management services	872,874	483	88.0
Other services	701,72,75-79,81, 83,84,89	1,245	83.4
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	6,249	84.8

See explanatory information and SOURCE at end of table.

Table B-3. Unit response rates percentage of companies that responded to survey, by industry: 1997

Industry	SIC code	Number of companies that received questionnaire	Response rate
All companies receiving Form RD-1L			
All Industries		2,537	84.6%
Manufacturing		1,480	85.6
Food, kindred, and tobacco products	20,21	71	85.9
Textiles and apparel	22,23	49	89.8
Lumber, wood products, and furniture	24,25	31	87.1
Paper and allied products	26	44	90.9
Chemicals and allied products	28	165	87.3
Industrial chemicals	281-82,286	60	91.7
Drugs and medicines	283	49	85.7
Other chemicals	284-85,287-89	56	83.9
Petroleum refining and extraction	13,29	20	90.0
Rubber products	30	105	84.8
Stone, clay, and glass products	32	34	88.2
Primary metals	33	59	86.4
Ferrous metals and products	331-32,3398-99	25	88.0
Nonferrous metals and products	333-36	34	85.3
Fabricated metal products	34	112	85.7
Machinery	35	229	86.9
Office, computing, and accounting machines	357	54	83.3
Other machinery, except electrical	351-56,358-59	175	88.0
Electrical equipment	36	254	80.7
Radio and TV receiving equipment	365	16	75.0
Communication equipment	366	72	76.4
Electronic components	367	93	83.9
Other electrical equipment	361-64,369	73	82.2
Transportation equipment	37	63	88.9
Motor vehicles and motor vehicles equipment	371	29	93.1
Other transportation equipment	373-75,379	9	88.9
Aircraft and missiles	372,376	25	84.0
Professional and scientific instruments	38	178	85.4
Scientific and mechanical measuring instruments	381-82	98	86.7
Optical, surgical, photographic, and other instruments	384-87	80	83.7
Other manufacturing industries [1]	27,31,39	66	83.3

See explanatory information and SOURCE at end of table.

Table B-3. Unit response rates percentage of companies that responded to survey, by industry: 1997

Industry	SIC code	Number of companies that received questionnaire	Response rate
Nonmanufacturing		1,057	83.2%
Transportation and utilities	40-42,44-49	70	84.3
Communications	48	17	100.0
Telephone communications	481	10	100.0
Other communications	482-484,489	7	100.0
Electric, gas, and sanitary services	49	40	80.0
Other transportation and utilities	40-42,44-47	13	76.9
Trade	50-59	113	82.3
Finance, insurance, and real estate	60-65,67	43	74.4
Services	701,72,73,75-81, 83,84,87,89	804	83.3
Business services	73	351	81.5
Computer and data processing services	737	328	81.1
Other business services	731-736,738	23	87.0
Health services	80	20	90.0
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	14	92.9
Other health services	802-805,808-809	6	83.3
Engineering and management services	87	418	84.4
Engineering, architectural, and surveying	871	142	82.4
Research, development, and testing	873	263	85.9
Other engineering and management services	872,874	13	76.9
Other services	701,72,75-79,81, 83,84,89	15	86.7
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	27	92.6

See explanatory information and SOURCE at end of table.

Table B-3. Unit response rates percentage of companies that responded to survey, by industry: 1997

Industry	SIC code	Number of companies that received questionnaire	Response rate
All companies receiving Form RD-1A			
All Industries		20,840	84.7%
Manufacturing		3,171	82.8
Food, kindred, and tobacco products	20,21	87	94.2
Textiles and apparel	22,23	139	82.7
Lumber, wood products, and furniture	24,25	139	88.5
Paper and allied products	26	52	86.5
Chemicals and allied products	28	82	75.6
Industrial chemicals	281-82,286	12	75.0
Drugs and medicines	283	4	100.0
Other chemicals	284-85,287-89	66	74.2
Petroleum refining and extraction	13,29	36	86.1
Rubber products	30	176	80.1
Stone, clay, and glass products	32	30	86.7
Primary metals	33	39	89.7
Ferrous metals and products	331-32,3398-99	16	100.0
Nonferrous metals and products	333-36	23	82.6
Fabricated metal products	34	294	83.0
Machinery	35	106	80.2
Office, computing, and accounting machines	357	8	62.5
Other machinery, except electrical	351-56,358-59	98	81.6
Electrical equipment	36	106	78.3
Radio and TV receiving equipment	365	4	50.0
Communication equipment	366	11	81.8
Electronic components	367	40	85.0
Other electrical equipment	361-64,369	51	74.5
Transportation equipment	37	20	80.0
Motor vehicles and motor vehicles equipment	371	12	91.7
Other transportation equipment	373-75,379	5	40.0
Aircraft and missiles	372,376	3	100.0
Professional and scientific instruments	38	162	75.3
Scientific and mechanical measuring instruments	381-82	104	80.8
Optical, surgical, photographic, and other instruments	384-87	58	65.5
Other manufacturing industries [1]	27,31,39	1,695	83.2

See explanatory information and SOURCE at end of table.

Table B-3. Unit response rates percentage of companies that responded to survey, by industry: 1997

Industry	SIC code	Number of companies that received questionnaire	Response rate
Nonmanufacturing		17,669	85.0%
Transportation and utilities	40-42,44-49	828	85.7
Communications	48	305	83.2
Telephone communications	481	23	87.0
Other communications	482-484,489	282	83.0
Electric, gas, and sanitary services	49	81	91.4
Other transportation and utilities	40-42,44-47	442	86.4
Trade	50-59	4,620	84.9
Finance, insurance, and real estate	60-65,67	792	87.5
Services	701,72,73,75-81, 83,84,87,89	5,207	85.0
Business services	73	1,154	80.2
Computer and data processing services	737	432	74.5
Other business services	731-736,738	722	83.7
Health services	80	806	87.0
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	459	88.2
Other health services	802-805,808-809	347	85.3
Engineering and management services	87	2,017	87.8
Engineering, architectural, and surveying	871	1,093	90.6
Research, development, and testing	873	454	80.8
Other engineering and management services	872,874	470	88.3
Other services	701,72,75-79,81, 83,84,89	1,230	83.4
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	6,222	84.7

[1] Beginning in 1996, manufacturing companies with fewer than 50 employees and nonmanufacturing companies with fewer than 15 employees were sampled separately without regard to industry classification to minimize year-to-year variation in survey estimates. Estimates for manufacturing companies in this group are combined with those for companies in "Other manufacturing industries." Estimates for nonmanufacturing companies in this group are combined with those for companies in "Other nonmanufacturing industries." As a result, statistics for "Other manufacturing industries" and for "Other nonmanufacturing industries" after 1995 are not comparable with statistics for prior years.

NOTES: The calculation of the response rate was based on all companies that responded to the survey, including those that reported they were out of scope, out of business, or had merged with another company. It excludes companies for which total R&D expenditure data were imputed.

The total number of companies is generally less than the number of companies sampled in Table B-1 because some companies selected for the survey went out of business or were merged with other companies during the time between survey sampling and survey mailout.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1997

Table B-4. Imputation rates for selected items, by industry: 1997

Industry	SIC code	Net Sales	Total employment	R&D scientists/ engineers	Total R&D			R&D by cost			R&D by State	Energy R&D	Pollution abatement	R&D outside company	Foreign R&D
					Total	Company	Federal	Wages	Materials	Other costs					
		[Percent]													
All Industries		9.5	9.0	36.8	8.5	9.1	27.8	63.9	68.5	68.7	58.1	13.4	38.1	5.1	5.6
Manufacturing		11.1	9.5	41.8	7.5	9.3	23.6	67.4	69.4	71.4	59.3	16.0	38.1	2.8	5.4
Food, kindred, and tobacco products	20,21	6.9	15.8	43.1	6.1	7.1	0.0	49.9	52.7	41.4	50.1	0.0	0.0	0.5	0.1
Textiles and apparel	22,23	7.0	14.2	30.7	12.1	12.1	0.0	65.4	71.0	67.2	64.4	0.0	0.0	0.0	0.0
Lumber, wood products, and furniture	24,25	6.9	4.9	20.4	2.6	7.5	0.0	54.3	43.2	56.5	57.9	0.0	0.0	10.4	0.0
Paper and allied products	26	17.3	19.8	81.4	48.1	47.4	99.6	84.5	84.4	84.5	84.9	0.0	0.0	74.2	0.0
Chemicals and allied products	28	5.5	6.9	28.0	4.9	4.0	58.0	66.4	62.8	62.4	53.5	2.8	25.7	2.0	1.5
Industrial chemicals	281-82,286	6.0	10.0	30.2	10.9	7.9	60.8	81.7	81.6	77.3	74.4	3.2	33.7	2.3	4.9
Drugs and medicines	283	3.9	2.8	18.4	1.5	1.4	62.3	59.6	55.2	60.4	45.3	0.0	0.0	2.1	0.5
Other chemicals	284-85,287-89	6.7	7.1	49.7	8.6	9.2	0.0	54.3	47.2	42.0	44.0	0.0	0.0	0.8	1.0
Petroleum refining and extraction	13,29	4.7	8.3	26.9	10.2	9.8	0.0	42.4	51.3	42.7	51.5	14.0	16.9	0.0	0.0
Rubber products	30	5.6	11.2	23.2	16.5	22.6	18.5	49.8	59.2	64.3	68.4	0.0	0.0	4.7	20.3
Stone, clay, and glass products	32	10.7	12.9	51.4	8.5	8.4	0.0	44.9	45.4	46.4	50.1	0.0	0.0	0.0	0.0
Primary metals	33	3.0	12.3	64.5	3.1	4.0	0.1	72.6	73.7	76.6	41.3	0.0	16.6	0.5	0.0
Ferrous metals and products	331-32, 3398-99	2.2	14.4	75.1	2.3	3.5	0.0	71.7	70.4	72.1	12.7	0.0	17.4	0.0	0.0
Nonferrous metals and products	333-36	4.0	8.9	47.3	4.5	4.6	2.0	73.8	75.5	86.0	77.7	0.0	0.0	0.9	0.0
Fabricated metal products	34	10.9	9.6	28.2	3.7	7.0	9.9	58.3	58.6	57.7	51.6	0.0	24.6	3.3	1.3
Machinery	35	10.5	8.0	22.5	8.9	24.8	10.0	50.1	50.7	49.3	42.3	32.0	48.2	4.2	11.9
Office, computing, and accounting machines	357	15.2	11.1	13.6	10.1	32.4	0.0	50.9	51.6	51.1	46.0	0.0	0.0	3.0	15.9
Other machinery, except electrical	351-56,358-59	7.0	6.6	35.3	6.2	7.6	19.9	47.6	49.3	43.4	33.1	32.0	48.2	5.5	4.2

See explanatory information and SOURCE at end of table.

Table B-4. Imputation rates for selected items, by industry: 1997

Industry	SIC code	Net Sales	Total employment	R&D scientists/ engineers	Total R&D			R&D by cost			R&D by State	Energy R&D	Pollution abatement	R&D outside company	Foreign R&D
					Total	Company	Federal	Wages	Materials	Other costs					
		[Percent]													
Electrical equipment	36	7.9	9.4	46.5	3.6	4.8	2.5	60.3	61.2	66.5	52.4	0.0	0.0	0.1	6.6
Radio and TV receiving equipment	365	10.6	15.8	23.2	41.1	41.1	41.7	47.3	49.8	48.6	44.9	0.0	0.0	6.8	0.0
Communication equipment	366	7.1	6.1	42.9	3.0	6.1	2.1	44.6	46.2	54.1	35.5	0.0	0.0	0.0	14.0
Electronic components	367	6.7	6.0	65.0	2.2	2.3	2.9	81.7	85.4	76.5	64.8	0.0	0.0	0.0	1.9
Other electrical equipment	361-64,369	9.3	13.4	18.5	6.6	7.7	2.0	30.8	53.0	56.2	50.4	0.0	0.0	0.0	0.6
Transportation equipment	37	27.9	4.0	57.2	5.1	3.2	17.1	84.8	81.2	91.6	75.4	0.0	1.3	0.9	2.3
Motor vehicles and motor vehicles equipment	371	35.7	0.3	35.5	0.1	0.2	0.0	84.9	74.0	97.2	85.0	0.0	0.0	0.0	0.0
Other transportation equipment	373-75,379	0.3	2.3	44.9	1.1	2.1	0.0	71.8	83.5	82.3	49.5	0.0	0.0	0.0	0.0
Aircraft and missiles	372,376	11.2	9.4	75.7	9.9	10.4	19.8	85.1	90.1	88.1	67.5	0.0	17.8	11.5	39.4
Professional and scientific instruments	38	10.3	11.6	60.2	18.2	8.5	37.6	76.9	82.8	83.6	63.2	0.0	0.0	7.5	0.9
Scientific and mechanical measuring instruments	381-82	13.0	11.6	67.7	26.0	11.7	38.2	79.5	84.2	85.4	69.8	0.0	0.0	0.5	3.1
Optical, surgical, photographic, and other instruments	384-87	7.7	11.4	45.8	6.3	6.3	8.5	72.8	81.0	80.8	53.3	0.0	0.0	10.4	0.5
Other manufacturing industries [1]	27,31,39	6.9	5.1	12.3	2.3	3.0	0.0	48.8	48.0	66.5	48.2	0.0	0.0	3.8	5.1
Nonmanufacturing		5.6	8.2	23.9	11.9	8.3	47.9	50.2	62.1	57.2	53.1	5.4	0.0	9.0	6.4
Transportation and utilities	40-42,44-49	4.3	4.5	35.2	20.7	23.6	8.7	70.2	67.2	71.5	71.3	0.0	0.0	3.8	0.0
Communications	48	0.0	0.0	57.8	27.4	32.8	0.0	73.8	74.4	75.1	73.8	0.0	0.0	1.4	0.0
Telephone communications	481	0.0	0.0	60.2	28.2	33.8	0.0	74.8	74.6	75.7	75.2	0.0	0.0	1.4	0.0
Other communications	482-484,489	0.0	0.5	24.8	0.0	0.0	0.0	29.1	50.8	50.8	11.2	0.0	0.0	0.0	0.0

See explanatory information and SOURCE at end of table.

Table B-4. Imputation rates for selected items, by industry: 1997

Industry	SIC code	Net Sales	Total employment	R&D scientists/ engineers	Total R&D			R&D by cost			R&D by State	Energy R&D	Pollution abatement	R&D outside company	Foreign R&D
					Total	Company	Federal	Wages	Materials	Other costs					
		[Percent]													
Electric, gas, and sanitary services	49	13.2	30.9	15.3	16.2	16.1	17.6	30.7	36.1	35.2	33.5	0.0	0.0	6.1	0.0
Other transportation and utilities	40-42,44-47	0.7	0.2	5.8	2.5	0.7	96.3	71.0	90.0	89.8	93.4	0.0	0.0	0.7	0.0
		1.8	4.8	14.2	4.4	4.4	0.0	66.6	76.0	68.4	46.1	0.0	0.0	1.2	13.4
Trade	50-59	5.2	7.1	55.1	3.9	3.8	100.0	10.7	64.8	65.1	53.0	0.0	0.0	29.0	0.0
Finance, insurance, and real estate	60-65,67	0.9	3.3	28.1	5.3	5.1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	70.6	0.0
Services	701,72, 73,75-81, 83,84,87,89	10.1	15.2	21.8	14.6	8.6	47.5	46.0	58.1	52.0	53.0	5.1	0.0	10.4	3.1
Business services	73	8.7	16.3	19.4	8.5	8.7	18.4	39.7	50.9	48.1	53.5	0.0	0.0	14.9	2.0
Computer and data processing services	737	10.6	17.4	19.7	8.3	8.5	19.0	40.0	51.3	48.6	54.2	0.0	0.0	15.1	2.0
Other business services	731-736,738	1.4	15.6	7.7	15.0	15.7	0.0	26.1	29.2	26.7	20.0	0.0	0.0	0.0	0.0
Health services	80	37.3	25.0	6.0	1.4	1.2	24.3	92.0	95.1	75.8	89.9	0.0	0.0	1.3	0.0
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	39.6	25.1	1.9	0.7	0.7	0.0	95.7	97.0	86.8	94.9	0.0	0.0	1.3	0.0
Other health services	802-805, 808-809	11.8	24.2	29.8	10.3	8.0	100.0	16.3	13.1	10.4	12.9	0.0	0.0	0.0	0.0
Engineering and management services	87	13.9	20.8	29.2	24.1	9.6	51.3	53.6	56.3	55.5	49.7	5.4	0.0	11.8	15.0
Engineering, architectural, and surveying	871	2.7	5.3	43.0	14.6	11.2	16.8	57.2	62.2	55.7	44.6	6.1	0.0	2.3	8.6
Research, development, and testing	873	33.1	42.4	21.5	28.1	9.3	71.5	52.3	55.2	55.3	50.6	4.3	0.0	12.1	16.6
Other engineering and management services	872,874	23.2	23.2	15.3	2.3	10.5	100.0	59.3	83.4	73.6	72.8	0.0	0.0	0.0	0.0

See explanatory information and SOURCE at end of table.

Table B-4. Imputation rates for selected items, by industry: 1997

Industry	SIC code	Net Sales	Total employment	R&D scientists/ engineers	Total R&D			R&D by cost			R&D by State	Energy R&D	Pollution abatement	R&D outside company	Foreign R&D
					Total	Company	Federal	Wages	Materials	Other costs					
		[Percent]													
Other services	701,72, 75-79,81, 83,84,89	0.3	0.2	4.5	2.9	3.0	0.0	22.4	30.8	28.8	15.4	0.0	0.0	0.2	2.6
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	1.4	1.7	27.3	1.8	1.9	0.0	24.0	22.0	23.5	24.4	0.0	0.0	0.0	10.4

[1] Beginning in 1996, manufacturing companies with fewer than 50 employees and nonmanufacturing companies with fewer than 15 employees were sampled separately without regard to industry classification to minimize year-to-year variation in survey estimates. Estimates for manufacturing companies in this group are combined with those for companies in "Other manufacturing industries." Estimates for nonmanufacturing companies in this group are combined with those for companies in "Other nonmanufacturing industries." As a result, statistics for "Other manufacturing industries" and for "Other nonmanufacturing industries" after 1995 are not comparable with statistics for prior years.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1997

Table B-5. Reported items--percentage of R&D-performing companies that reported data for selected items: 1997

Data Item	Percent that reported data item [1]	
	Form RD-1L [2]	Form RD-1A [2]
Sales	99.1%	99.0%
Total employment	96.8	98.9
Scientist and engineers	76.4	87.3
Federal R&D [3]	98.3	100.0
Company R&D [3]	98.3	100.0
Total R&D	100.0	100.0
Foreign R&D	24.1	4.3
Contracted out	18.2	12.9
Energy R&D	3.9	[4]
Pollution abatement R&D	4.5	[4]

[1] Percentages are based on companies that reported total R&D expenditures. Imputed data are not included. Companies that reported they were out of scope, out of business, merged with another company, or had no R&D expenditures for 1997 were excluded from the calculation.

[2] See technical notes for descriptions of the survey questionnaire forms.

[3] Item response for "Federal R&D" and for "Company R&D" are considered together; companies that report "Total R&D" and either of these expenditures implicitly report both company and Federal R&D, since these two items sum to total R&D.

[4] Percentages are not provided because Form RD-1A, the abbreviated questionnaire, does not include these items. See the technical notes for more information about the contents of the survey questionnaires.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1997

data were collected and was based on a character of work distribution reported in either of the 2 previous years, if any. It was again performed using new data collected in the next 2 years. If reported data followed no previously imputed or reported data, previous period estimates were inserted based on the currently reported information. Similarly, if reported data did not follow 2 years of imputed data, the 2 years of previously imputed data were removed. Thus, character of work estimates were revised as newly reported information became available and were not final for 2 years following their initial publication.

Beginning with 1995, previously estimated values were not removed for firms that did not report in the third year, nor were estimates made for the 2 previous years for firms reporting after 2 years of nonresponse. This process was changed because, in the prior period, revisions were minimal. Estimates continue to be made for 2 consecutive years of nonresponse and discontinued if the firm does not report character of work in the third year.

If no reported data are available for a firm, character of work estimates are not imputed. As a consequence, only a portion of the total estimated R&D expenditures are distributed at the firm level. Those expenditures not meeting the requirements of the new imputation methodology are placed in a "not distributed" category. Tables B-6, B-7, and B-8 show the character of work estimates along with the "not distributed" component for 1995, 1996, and 1997, respectively. NSF's objective in conducting the survey has always been to provide estimates for the entire population of firms performing R&D in the United States. However, the revised imputation procedure would no longer produce such estimates because of the "not distributed" component. A baseline estimation method was thus developed to allocate the "not distributed" amounts among the character of work components. In the baseline estimation method, the "not distributed" expenditures are allocated by industry group to basic research, applied research, and development categories using the percentage splits in the distributed category for that industry. The allocation is done at the lowest level of published industry detail only; higher levels are derived by aggregation, just as national totals are derived by aggregation of individual industry estimates, and result in higher performance shares for basic and applied research and lower estimates for development's share than would have been calculated using the previous method.[9] The estimates of basic research, applied research, and development provided in the tables in section A were calculated using the baseline estimation method.

State Estimates

Form RD-1L requests data on the cost of R&D performed for states in which a company's R&D laboratories are located. An independent source, the *Directory of American Research and Development*, published by the Data Base Publishing Group of the R. R. Bowker Company, is used in conjunction with survey results to estimate R&D expenditures by state for companies that do not provide this information. The information on scientists and engineers published in the directory is used as a proxy indicator of the proportion of R&D expenditures within each state. R&D expenditures by state are estimated by applying the distribution of scientists and engineers by state from the directory to total R&D expenditures for these companies. These estimates are included with reported survey data to arrive at published estimates of R&D expenditures for each state.

[9] See NSF (1990) for an explanation of the uncertainties in the data and to quantify their sensitivity to the choice of various possible imputation procedures.

Table B-6. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1995

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
All Industries		132,103	23,451	108,652	5,093	511	4,581	22,470	2,725	19,744
Distribution by industry:										
Manufacturing		100,067	18,831	81,236	3,086	207	2,879	16,154	1,575	14,579
Food, kindred, and tobacco products	20,21	1,566	0	1,566	136	0	136	453	0	453
Textiles and apparel	22,23	(D)	(D)	381	22	0	22	(D)	(D)	37
Lumber, wood products, and furniture	24,25	(D)	(D)	229	17	0	17	31	0	31
Paper and allied products	26	(D)	(D)	1,404	193 (S)	0	193 (S)	(D)	(D)	556 (S)
Chemicals and allied products	28	17,547	210 (S)	17,337	(D)	(D)	1,225	(D)	(D)	4,348
Industrial chemicals	281-82,286	(D)	(D)	5,139	(D)	(D)	426	(D)	(D)	1,191
Drugs and medicines	283	10,215	14	10,202	720	2	718	2,484	5	2,479
Other chemicals	284-85,287-89	(D)	(D)	1,996	(D)	(D)	81	(D)	(D)	678
Petroleum refining and extraction	13,29	1,760	6	1,754	84	0	84	(D)	(D)	523
Rubber products	30	(D)	(D)	1,210	55	0	55	(D)	(D)	174
Stone, clay, and glass products	32	448	6	441	15	0	15	(D)	(D)	136
Primary metals	33	593	13	580	30	0	30	(D)	(D)	134
Ferrous metals and products	331-32,3398-99	(D)	(D)	217	13	0	13	77	0	77
Nonferrous metals and products	333-36	(D)	(D)	363	18	0	18	(D)	(D)	57
Fabricated metal products	34	1,023	86	937	(D)	(D)	60	138	9	128
Machinery	35	(D)	(D)	9,676	(D)	(D)	220	2,153	27	2,126
Office, computing, and accounting machines	357	(D)	(D)	4,699	(D)	(D)	22	(D)	(D)	1,227
Other machinery, except electrical	351-56,358-59	5,041	64	4,976	(D)	(D)	198	(D)	(D)	899
Electrical equipment	36	18,751	1,690	17,060	(D)	(D)	178	(D)	(D)	2,229
Radio and TV receiving equipment	365	(D)	(D)	114	4	0	4	13	0	13
Communication equipment	366	(D)	(D)	3,845	48	0	48	(D)	(D)	568
Electronic components	367	(D)	(D)	9,628	(D)	(D)	50	1,207	33	1,174
Other electrical equipment	361-64,369	(D)	(D)	3,473	(D)	(D)	76	(D)	(D)	474
Transportation equipment	37	32,441	13,130	19,311	280	180	100	2,248	548	1,700
Motor vehicles and motor vehicles equipment	371	(D)	(D)	13,590	(D)	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	232	(D)	(D)	(D)	(D)	(D)	(D)
Aircraft and missiles	372,376	16,951	11,462	5,489	185	180	5	1,459	406	1,052
Professional and scientific instruments	38	11,976	3,460 (S)	8,516	(D)	(D)	472	(D)	(D)	1,929
Scientific and mechanical measuring instruments	381-82	7,146	3,358 (S)	3,787	(D)	(D)	252	(D)	(D)	1,373
Optical, surgical, photographic, and other instruments	384-87	4,831	102	4,729	(D)	(D)	220	579	23	556
Other manufacturing industries	27,31,39	(D)	(D)	835	(D)	(D)	71	73	0	73

See explanatory information and SOURCE at end of table.

Table B-6. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1995

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
Distribution by industry:										
Nonmanufacturing		32,036	4,620	27,415	2,006	304	1,702	6,316	1,150	5,166
Transportation and utilities	40-42,44-49	5,435	252	5,183	(D)	(D)	106	(D)	(D)	938
Communications	48	(D)	(D)	4,756	(D)	0	(D)	(D)	0	(D)
Telephone communications	481	(D)	(D)	4,697	(D)	0	(D)	(D)	0	(D)
Other communications	482-484,489	59	0	59	(D)	0	(D)	(D)	0	(D)
Electric, gas, and sanitary services	49	440	93	347	(D)	(D)	43	(D)	(D)	93
Other transportation and utilities	40-42,44-47	(D)	(D)	80	(D)	0	(D)	(D)	(D)	(D)
Trade	50-59	(D)	(D)	7,514	(D)	(D)	207	(D)	(D)	1,213
Finance, insurance, and real estate	60-65,67	(D)	(D)	710	(D)	(D)	115	(D)	(D)	16
Services	701,72,73,75-81, 83,84,87,89	17,876	4,270	13,606	1,537	294	1,243	3,979	1,129	2,850
Business services	73	9,293	612	8,681	(D)	(D)	(D)	(D)	(D)	(D)
Computer and data processing services	737	9,059	514	8,545	(D)	(D)	550	(D)	(D)	1,338
Other business services	731-736,738	234	98	136	(D)	(D)	(D)	(D)	(D)	(D)
Health services	80	756	4	753	(D)	(D)	(D)	237	3	235
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	(D)	(D)	737	(D)	(D)	(D)	(D)	(D)	(D)
Other health services	802-805,808-809	(D)	(D)	16 (S)	1	(D)	(D)	(D)	(D)	(D)
Engineering and management services	87	7,662	3,650	4,011	(D)	(D)	(D)	(D)	(D)	(D)
Engineering, architectural, and surveying	871	2,933	1,883	1,050	(D)	(D)	(D)	(D)	(D)	(D)
Research, development, and testing	873	(D)	(D)	2,829	(D)	(D)	(D)	(D)	(D)	(D)
Other engineering and management services	872,874	(D)	(D)	132	(D)	(D)	7	(D)	(D)	0
Other services	701,72,75-79,81, 83,84,89	165	4	160	(D)	(D)	(D)	29	3	26
Other nonmanufacturing industries	07-12,14,15, 161-162,17	413	11	402	31	0	31	(D)	(D)	148

See explanatory information and SOURCE at end of table.

Table B-6. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1995

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
Distribution by size of company: [Number of employees]										
Total		132,103	23,451	108,652	5,093	511	4,581	22,470	2,725	19,744
Fewer than 500		16,662	1,978	14,684	1,872	272	1,600	4,457	789	3,668
500 to 999		4,693	225	4,468	(D)	(D)	266	(D)	(D)	1,121
1,000 to 4,999		16,960	798	16,162	1,263	26 (S)	1,237	3,220	42	3,177
5,000 to 9,999		9,532	243	9,289	(D)	(D)	187	2,203	60 (S)	2,143
10,000 to 24,999		17,071	1,946 (S)	15,125	559	3	556	(D)	(D)	2,351
25,000 or more		67,185	18,261	48,924	922	186	736	8,638	1,354	7,284

See explanatory information and SOURCE at end of table.

Table B-6. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1995

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
All Industries		83,616	14,679	68,938	20,925	5,536	15,388	16.0	24.0	14.0
Distribution by industry:										
Manufacturing		62,201	12,746	49,455	18,626	4,302	14,324	19.0	23.0	18.0
Food, kindred, and tobacco products	20,21	803	0	803	174	0	174	11.0	0.0	11.0
Textiles and apparel	22,23	(D)	(D)	228	(D)	(D)	94	(D)	(D)	25.0
Lumber, wood products, and furniture	24,25	(D)	(D)	136	(D)	(D)	45	(D)	(D)	20.0
Paper and allied products	26	345	0	345	(D)	(D)	310	(D)	(D)	22.0
Chemicals and allied products	28	7,936	186 (S)	7,750	(D)	(D)	4,013	(D)	(D)	23.0
Industrial chemicals	281-82,286	(D)	(D)	2,619	(D)	(D)	903	(D)	(D)	18.0
Drugs and medicines	283	4,018	7	4,011	2,994	0	2,994	29.0	0.0	29.0
Other chemicals	284-85,287-89	(D)	(D)	1,119	(D)	(D)	117	(D)	(D)	6.0
Petroleum refining and extraction	13,29	(D)	(D)	669	(D)	0	478 (D)	(D)	0.0	(D)
Rubber products	30	(D)	(D)	753	(D)	(D)	228	(D)	(D)	19.0
Stone, clay, and glass products	32	(D)	(D)	249	41	0	41 (D)	9.0	0.0	9.0
Primary metals	33	(D)	(D)	236	(D)	(D)	179	(D)	(D)	31.0
Ferrous metals and products	331-32,3398-99	(D)	(D)	108	(D)	(D)	19 (D)	(D)	(D)	(D)
Nonferrous metals and products	333-36	130	2	128	(D)	(D)	160 (D)	45.0	64.0	(D)
Fabricated metal products	34	(D)	(D)	654	(D)	(D)	95	(D)	(D)	10.0
Machinery	35	6,209	48	6,162	(D)	(D)	1,168	12.0	10.0	12.0
Office, computing, and accounting machines	357	(D)	(D)	3,111 (S)	(D)	(D)	339	(D)	(D)	7.0
Other machinery, except electrical	351-56,358-59	(D)	(D)	3,051	(D)	(D)	829	(D)	(D)	17.0
Electrical equipment	36	9,689	446	9,243	(D)	(D)	5,410	(D)	(D)	32.0
Radio and TV receiving equipment	365	(D)	(D)	78	(D)	(D)	18	(D)	(D)	16.0
Communication equipment	366	3,119	52	3,067	(D)	(D)	162 (D)	14.0	90.0	(D)
Electronic components	367	3,820	13	3,807	(D)	(D)	4,598 (D)	50.0	92.0	(D)
Other electrical equipment	361-64,369	(D)	(D)	2,292	(D)	(D)	631	16.0	0.0	18.0
Transportation equipment	37	25,250	9,192	16,057	4,663	3,211	1,453	14.0	24.0	8.0
Motor vehicles and motor vehicles equipment	371	(D)	(D)	12,807	(D)	(D)	83	(D)	(D)	1.0
Other transportation equipment	373-75,379	(D)	(D)	118	(D)	(D)	72	14.0	1.0	31.0
Aircraft and missiles	372,376	10,802	7,669	3,133	4,504	3,206	1,298	27.0	28.0	24.0
Professional and scientific instruments	38	8,384	2,795 (S)	5,589	(D)	(D)	526	(D)	(D)	6.0
Scientific and mechanical measuring instruments	381-82	(D)	(D)	2,052	(D)	(D)	110 (S)	(D)	(D)	3.0
Optical, surgical, photographic, and other instruments	384-87	(D)	(D)	3,537	(D)	(D)	416	(D)	(D)	9.0
Other manufacturing industries	27,31,39	581	0	581	(D)	(D)	110	(D)	(D)	13.0

See explanatory information and SOURCE at end of table.

Table B-6. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1995

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
Distribution by industry:										
Nonmanufacturing		21,415	1,932	19,483	2,299	1,234	1,065	7.0	27.0	4.0
Transportation and utilities	40-41,44-49	4,285	232	4,053	(D)	(D)	85	(D)	(D)	2.0
Communications	48	(D)	(D)	3,849	(D)	0	(D)	0.0	0.0	0.0
Telephone communications	481	(D)	(D)	3,809	0	0	0	0.0	0.0	0.0
Other communications	482-484,489	41	0	41	(D)	0	(D)	(D)	0.0	(D)
Electric, gas, and sanitary services	49	250	86	163	(D)	0	48	11.0	0.0	14.0
Other transportation and utilities	40-42,44-47	(D)	(D)	40	(D)	(D)	(D)	51.0	100.0	(D)
Trade	50-59	(D)	(D)	5,956	(D)	(D)	139	(D)	(D)	2.0
Finance, insurance, and real estate	60-65,67	(D)	(D)	575	(D)	(D)	4	(D)	(D)	1.0
Services	701,72,73,75-81, 83,84,87,89	10,315	1,626	8,690	2,045	1,221	823	11.0	29.0	6.0
Business services	73	6,691	258	6,434	(D)	(D)	(D)	(D)	(D)	(D)
Computer and data processing services	737	6,533	178	6,355	(D)	(D)	301	(D)	(D)	4.0
Other business services	731-736,738	158	80	78	(D)	0	(D)	(D)	0.0	(D)
Health services	80	(D)	(D)	(D)	0	0	0	0.0	0.0	0.0
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	(D)	(D)	(D)	0	0	0	0.0	0.0	0.0
Other health services	802-805,808-809	7	0	7	0	0	0	0.0	0.0	0.0
Engineering and management services	87	3,031	1,367 (S)	1,664	(D)	(D)	498	(D)	(D)	12.0
Engineering, architectural, and surveying	871	799	482	317	(D)	(D)	(D)	(D)	(D)	(D)
Research, development, and testing	873	(D)	(D)	1,222	(D)	(D)	(D)	6.0	7.0	(D)
Other engineering and management services	872,874	(D)	(D)	125	0	0	0	0.0	0.0	0.0
Other services	701,72,75-79,81, 83,84,89	(D)	(D)	(D)	(D)	0	(D)	(D)	0.0	(D)
Other nonmanufacturing industries	07-12,14,15, 161-162,17	(D)	(D)	209	13	0	13	3.0	0.0	3.0

See explanatory information and SOURCE at end of table.

Table B-6. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1995

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
Distribution by size of company: [Number of employees]										
Total		83,616	14,679	68,938	20,925	5,536	15,388	16.0	24.0	14.0
Fewer than 500		9,406	847	8,559	926	69	857	6.0	3.0	6.0
500 to 999		2,907	156	2,751	(D)	(D)	330 (S)	(D)	(D)	7.0
1,000 to 4,999		10,617	633	9,984	1,860	96	1,764	11.0	12.0	11.0
5,000 to 9,999		6,444	153 (S)	6,291	(D)	(D)	669	(D)	(D)	7.0
10,000 to 24,999		10,386	1,377 (S)	9,009	(D)	(D)	3,209	(D)	(D)	21.0
25,000 or more		43,856	11,513	32,343	13,768	5,208	8,560	20.0	29.0	17.0

KEY: (D) = Data have been withheld to avoid disclosing operations of individual companies.
(S) = Indicates imputation of more than 50 percent.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1997

Table B-7. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1996

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
All Industries		144,667	23,653	121,015	7,011	1,114	5,897	24,386	3,013	21,373
Distribution by industry:										
Manufacturing		111,864	20,020	91,845	(D)	(D)	3,948	(D)	(D)	15,714
Food, kindred, and tobacco products	20,21	1,564	0	1,564	87	0	87	443	0	443
Textiles and apparel	22,23	(D)	(D)	414	37	0	37	(D)	(D)	32
Lumber, wood products, and furniture	24,25	(D)	(D)	634	29	0	29	(D)	(D)	94
Paper and allied products	26	(D)	(D)	1,534	255 (S)	0	255 (S)	(D)	(D)	567 (S)
Chemicals and allied products	28	(D)	(D)	17,520	1,322	8	1,314	(D)	(D)	4,651
Industrial chemicals	281-82,286	(D)	(D)	5,246	(D)	(D)	599	(D)	(D)	1,260
Drugs and medicines	283	9,773	3	9,769	(D)	(D)	651	(D)	(D)	2,401
Other chemicals	284-85,287-89	2,505	0	2,505	64	0	64	991	0	991
Petroleum refining and extraction	13,29	1,654	24	1,630	(D)	(D)	(D)	416	2	414
Rubber products	30	(D)	(D)	1,269	(D)	(D)	55	(D)	(D)	188
Stone, clay, and glass products	32	468	5	463	(D)	(D)	19	(D)	(D)	148
Primary metals	33	(D)	(D)	637	(D)	(D)	(D)	(D)	(D)	138
Ferrous metals and products	331-32,3398-99	(D)	(D)	214	5	(D)	(D)	(D)	0	(D)
Nonferrous metals and products	333-36	(D)	(D)	422	(D)	0	(D)	(D)	(D)	(D)
Fabricated metal products	34	(D)	(D)	1,322	(D)	(D)	86	(D)	(D)	152
Machinery	35	13,455	117	13,338	(D)	(D)	337	(D)	(D)	2,150
Office, computing, and accounting machines	357	(D)	(D)	8,132	(D)	(D)	59	(D)	(D)	1,498
Other machinery, except electrical	351-56,358-59	(D)	(D)	5,206	(D)	(D)	278	(D)	(D)	653
Electrical equipment	36	22,498	2,143	20,356	(D)	(D)	443	(D)	(D)	3,389
Radio and TV receiving equipment	365	(D)	(D)	140	21	(D)	(D)	(D)	0	(D)
Communication equipment	366	(D)	(D)	4,359	(D)	(D)	59	(D)	(D)	662
Electronic components	367	(D)	(D)	12,497	(D)	(D)	(D)	2,665	(D)	(D)
Other electrical equipment	361-64,369	(D)	(D)	3,360	(D)	(D)	217	(D)	(D)	545
Transportation equipment	37	32,737	12,202	20,535	(D)	(D)	190	(D)	(D)	1,992
Motor vehicles and motor vehicles equipment	371	(D)	(D)	14,528	103	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	298	(D)	0	(D)	86	(D)	(D)
Aircraft and missiles	372,376	16,224	10,515	5,710	(D)	(D)	(D)	(D)	(D)	(D)
Professional and scientific instruments	38	12,149	3,942	8,207	(D)	(D)	789	934	52	882
Scientific and mechanical measuring instruments	381-82	(D)	(D)	3,283	(D)	(D)	315	333	18	315
Optical, surgical, photographic, and other instruments	384-87	(D)	(D)	4,924	(D)	(D)	474	600	34	567
Other manufacturing industries [1]	27,31,39	(D)	(D)	2,423	(D)	(D)	234	924	451	473

See explanatory information and SOURCE at end of table.

Table B-7. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1996

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
Distribution by industry:										
Nonmanufacturing		32,803	3,633	29,170	(D)	(D)	1,949	(D)	(D)	5,659
Transportation and utilities	40-42,44-49	4,678	186	4,492	(D)	(D)	(D)	(D)	(D)	(D)
Communications	48	(D)	(D)	3,970	(D)	0	(D)	(D)	(D)	(D)
Telephone communications	481	(D)	(D)	3,897	(D)	0	(D)	(D)	(D)	(D)
Other communications	482-484,489	73	0	73	(D)	0	(D)	16	(D)	(D)
Electric, gas, and sanitary services	49	352	42	311	14	0	14	(D)	(D)	73
Other transportation and utilities	40-42,44-47	(D)	(D)	211	(D)	(D)	(D)	(D)	0	(D)
Trade	50-59	6,389	51 (S)	6,338	(D)	(D)	391	1,462	0	1,462
Finance, insurance, and real estate	60-65,67	(D)	(D)	1,280	12	(D)	(D)	(D)	0	(D)
Services	701,72,73,75-81, 83,84,87,89	19,022	3,118	15,904	1,618	306	1,312	3,952	1,006 (S)	2,946
Business services	73	10,641	361	10,280	550	48	501	1,328	51	1,277
Computer and data processing services	737	(D)	(D)	10,025	510	48	461	(D)	(D)	1,244
Other business services	731-736,738	(D)	(D)	255	40	0	40	(D)	(D)	33
Health services	80	(D)	(D)	735 (S)	(D)	(D)	51	(D)	(D)	252 (S)
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	715 (S)	3	713 (S)	48	(D)	(D)	(D)	(D)	(D)
Other health services	802-805,808-809	(D)	(D)	23	(D)	0	(D)	12	(D)	(D)
Engineering and management services	87	7,318	2,746	4,572	992	256	735	2,324	949 (S)	1,376
Engineering, architectural, and surveying	871	1,660	994	667	(D)	(D)	(D)	(D)	(D)	(D)
Research, development, and testing	873	5,484	1,708 (S)	3,776	762	114	648	1,772	603 (S)	1,168
Other engineering and management services	872,874	173	45	129	(D)	(D)	(D)	(D)	(D)	(D)
Other services	701,72,75-79,81, 83,84,89	(D)	(D)	317	(D)	(D)	24	(D)	(D)	42
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	(D)	(D)	1,156	44	0	44	547	218	329

See explanatory information and SOURCE at end of table.

Table B-7. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1996

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
Distribution by size of company: [Number of employees]										
Total		144,667	23,653	121,015	7,011	1,114	5,897	24,386	3,013	21,373
Fewer than 500		20,249	2,301	17,948	2,075	231	1,844	5,264	1,159	4,105
500 to 999		4,637	219	4,418	(D)	(D)	443	(D)	(D)	1,080
1,000 to 4,999		18,273	512	17,761	1,355	78	1,277	3,597	59	3,538
5,000 to 9,999		11,537	468	11,068	(D)	(D)	353	2,160	168	1,992
10,000 to 24,999		20,164	1,031 (S)	19,133	1,136	3 (S)	1,133	3,613	63 (S)	3,550
25,000 or more		69,808	19,122	50,686	(D)	(D)	847	(D)	(D)	7,108

See explanatory information and SOURCE at end of table.

Table B-7. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1996

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
Distribution by industry:										
All Industries		91,852	14,420 (S)	77,434	21,418	5,106	16,311	14.8	21.6	13.5
Manufacturing		69,607	12,741	56,868	20,004	4,689	15,315	17.9	23.4	16.7
Food, kindred, and tobacco products	20,21	835	0	835	199	0	199	12.7	0.0	12.7
Textiles and apparel	22,23	(D)	(D)	236	(D)	(D)	109	26.2	0.0	26.3
Lumber, wood products, and furniture	24,25	371	0	371	(D)	(D)	140	21.9	9.1	22.1
Paper and allied products	26	(D)	(D)	420	(D)	(D)	292	18.5	0.0	19.0
Chemicals and allied products	28	(D)	(D)	8,297	(D)	(D)	(D)	18.1	0.0	(D)
Industrial chemicals	281-82,286	(D)	(D)	2,590	(D)	(D)	(D)	13.9	0.0	(D)
Drugs and medicines	283	4,379	2 (S)	4,376	2,341	0	2,341	24.0	0.0	24.0
Other chemicals	284-85,287-89	1,329	0	1,329	121	0	121	4.8	0.0	4.8
Petroleum refining and extraction	13,29	(D)	(D)	(D)	(D)	0	(D)	(D)	0.0	(D)
Rubber products	30	(D)	(D)	780	(D)	(D)	246	17.7	0.0	19.4
Stone, clay, and glass products	32	(D)	(D)	255	41	0	41	8.8	0.0	8.9
Primary metals	33	598 (S)	(D)	(D)	190	(D)	(D)	20.0	1.0	(D)
Ferrous metals and products	331-32,3398-99	(D)	(D)	(D)	(D)	0	(D)	(D)	0.0	(D)
Nonferrous metals and products	333-36	(D)	(D)	176	(D)	(D)	(D)	22.7	1.0	(D)
Fabricated metal products	34	(D)	(D)	594	(D)	(D)	490	38.7	75.0	37.1
Machinery	35	9,412	67	9,345	(D)	(D)	1,506	(D)	(D)	11.3
Office, computing, and accounting machines	357	(D)	(D)	5,920	(D)	(D)	655	8.0	0.0	8.1
Other machinery, except electrical	351-56,358-59	(D)	(D)	3,424	(D)	(D)	851	16.3	13.6	16.3
Electrical equipment	36	11,075	316	10,761	(D)	(D)	5,763	(D)	(D)	28.3
Radio and TV receiving equipment	365	(D)	(D)	102	(D)	0	(D)	5.0	0.0	(D)
Communication equipment	366	3,466	30	3,437	(D)	(D)	201	13.3	92.7	4.6
Electronic components	367	4,869	47	4,822	(D)	(D)	(D)	44.5	59.5	(D)
Other electrical equipment	361-64,369	(D)	(D)	2,401	(D)	(D)	197	5.3	0.0	5.9
Transportation equipment	37	25,833	9,225 (S)	16,607	3,509	1,763	1,746	10.7	14.4	8.5
Motor vehicles and motor vehicles equipment	371	(D)	(D)	13,673	(D)	(D)	(D)	0.5	0.0	0.6
Other transportation equipment	373-75,379	(D)	(D)	82	(D)	(D)	(D)	48.4	51.1	(D)
Aircraft and missiles	372,376	10,682	7,830 (S)	2,852	3,153	1,628	1,525	19.4	15.5	26.7
Professional and scientific instruments	38	(D)	(D)	5,834	(D)	(D)	702	(D)	(D)	8.6
Scientific and mechanical measuring instruments	381-82	(D)	(D)	2,089	(D)	(D)	564	30.9	42.7	17.2
Optical, surgical, photographic, and other instruments	384-87	(D)	(D)	3,745	(D)	(D)	138	2.8	3.6	2.8
Other manufacturing industries [1]	27,31,39	1,650	79	1,571	(D)	(D)	145	5.1	0.9	6.0

See explanatory information and SOURCE at end of table.

Table B-7. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1996

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
Distribution by industry:										
Nonmanufacturing		22,245	1,679 (S)	20,566	1,414	418 (S)	996	4.3	11.5	3.4
Transportation and utilities	40-41,44-49	3,560	164	3,395	(D)	(D)	78	(D)	(D)	1.7
Communications	48	(D)	(D)	3,038	(D)	0	(D)	(D)	0.0	(D)
Telephone communications	481	(D)	(D)	2,982	0	0	0	0.0	0.0	0.0
Other communications	482-484,489	(D)	(D)	55	(D)	0	(D)	(D)	0.0	(D)
Electric, gas, and sanitary services	49	(D)	(D)	190	34	0	34	9.7	0.0	10.9
Other transportation and utilities	40-42,44-47	163	0	163	58	(D)	(D)	(D)	100.0	(D)
Trade	50-59	(D)	(D)	4,262	223	0	223	3.5	0.0	3.5
Finance, insurance, and real estate	60-65,67	1,171	0	1,171	(D)	(D)	(D)	0.5	100.0	(D)
Services	701,72,73,75-81, 83,84,87,89	12,417	1,458 (S)	10,959	1,035 (S)	348 (S)	687 (S)	5.4	11.2	4.3
Business services	73	7,993	114	7,879	770 (S)	148	623 (S)	7.2	41.0	6.1
Computer and data processing services	737	(D)	(D)	7,706	(D)	148	(D)	7.3	(D)	(D)
Other business services	731-736,738	(D)	(D)	173	(D)	0	(D)	3.3	0.0	(D)
Health services	80	(D)	(D)	431 (S)	(D)	0	(D)	(D)	0.0	(D)
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	(D)	(D)	(D)	(D)	0	(D)	(D)	0.0	(D)
Other health services	802-805,808-809	(D)	0	(D)	0	0	0	0.0	0.0	0.0
Engineering and management services	87	3,738	1,340 (S)	2,397	264 (S)	201 (S)	64	3.6	7.3	1.4
Engineering, architectural, and surveying	871	913	530	384	(D)	(D)	(D)	(D)	(D)	(D)
Research, development, and testing	873	2,725	810 (S)	1,915	225 (S)	181 (S)	45	4.1	10.6	1.2
Other engineering and management services	872,874	98	1	97	(D)	(D)	(D)	(D)	(D)	(D)
Other services	701,72,75-79,81, 83,84,89	(D)	(D)	251	(D)	0	(D)	(D)	0.0	(D)
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	(D)	(D)	778	(D)	(D)	(D)	4.0	18.5	(D)

See explanatory information and SOURCE at end of table.

Table B-7. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1996

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
Distribution by size of company: [Number of employees]										
Total		91,852	14,420 (S)	77,434	21,418	5,106	16,311	14.8	21.6	13.5
Fewer than 500		11,922	726	11,197	988	185	802	4.9	8.0	4.5
500 to 999		2,603	123	2,480	(D)	(D)	415 (S)	(D)	(D)	9.4
1,000 to 4,999		11,754	250	11,504	1,567	125 (S)	1,442	8.6	24.4	8.1
5,000 to 9,999		8,171	289	7,881	(D)	(D)	842	(D)	(D)	7.6
10,000 to 24,999		11,645	665 (S)	10,980	3,770	300	3,470	18.7	29.1	18.1
25,000 or more		45,758	12,368 (S)	33,392	13,805	4,464	9,341	19.8	23.3	18.4

[1] Beginning in 1996, manufacturing companies with fewer than 50 employees and nonmanufacturing companies with fewer than 15 employees were sampled separately without regard to industry classification to minimize year-to-year variation in survey estimates. Estimates for manufacturing companies in this group are combined with those for companies in "Other manufacturing industries." Estimates for nonmanufacturing companies in this group are combined with those for companies in "Other nonmanufacturing industries." As a result, statistics for "Other manufacturing industries" and for "Other nonmanufacturing industries" after 1995 are not comparable with statistics for prior years.

KEY: (D) = Data have been withheld to avoid disclosing operations of individual companies.
(S) = Indicates imputation of more than 50 percent.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1997

Table B-8. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1997

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
All Industries		157,539	23,928	133,611	8,623	1,173	7,450	25,597	1,822	23,775
Distribution by industry:										
Manufacturing		121,025	19,823	101,202	(D)	(D)	4,926	(D)	(D)	17,046
Food, kindred, and tobacco products	20,21	1,787	0	1,787	115	0	115	415	0	415
Textiles and apparel	22,23	(D)	(D)	476	37	0	37	31	0	31
Lumber, wood products, and furniture	24,25	348	0	348	(D)	0	(D)	35	0	35
Paper and allied products	26	(D)	(D)	1,456	82	0	82	(D)	(D)	104
Chemicals and allied products	28	(D)	(D)	18,628	(D)	(D)	2,303	(D)	(D)	4,346
Industrial chemicals	281-82,286	(D)	(D)	4,970	(D)	(D)	614	(D)	(D)	1,238
Drugs and medicines	283	11,589	3 (S)	11,586	(D)	(D)	1,609	2,529	0	2,529
Other chemicals	284-85,287-89	(D)	(D)	2,072	80	0	80	(D)	(D)	578
Petroleum refining and extraction	13,29	(D)	(D)	1,612	(D)	0	(D)	(D)	(D)	462
Rubber products	30	(D)	(D)	1,372	53	0	53	(D)	(D)	186
Stone, clay, and glass products	32	608	2	606	(D)	(D)	(D)	(D)	(D)	193
Primary metals	33	988	221	767	(D)	(D)	29	(D)	(D)	129
Ferrous metals and products	331-32,3398-99	(D)	(D)	414	(D)	(D)	(D)	(D)	(D)	(D)
Nonferrous metals and products	333-36	(D)	(D)	353	(D)	0	(D)	(D)	(D)	(D)
Fabricated metal products	34	1,798	129	1,669	(D)	(D)	81	309	84	225
Machinery	35	18,499	106	18,393	(D)	(D)	459	(D)	(D)	3,334
Office, computing, and accounting machines	357	12,840	53	12,787	(D)	(D)	149	(D)	(D)	2,587
Other machinery, except electrical	351-56,358-59	5,659	53	5,606	310	0	310	(D)	(D)	746
Electrical equipment	36	24,585	1,839	22,747	655	17 (S)	638	4,188	119	4,069
Radio and TV receiving equipment	365	(D)	(D)	152	26	0	26	(D)	(D)	(D)
Communication equipment	366	(D)	(D)	7,377	(D)	(D)	145	1,002	(D)	(D)
Electronic components	367	(D)	(D)	10,786	211	0	211	2,294	34 (S)	2,260
Other electrical equipment	361-64,369	4,909	477	4,432	(D)	(D)	255	(D)	(D)	795
Transportation equipment	37	31,993	12,251	19,742	(D)	(D)	132	(D)	(D)	2,019
Motor vehicles and motor vehicles equipment	371	(D)	(D)	13,758	103	(D)	(D)	(D)	(D)	(D)
Other transportation equipment	373-75,379	(D)	(D)	307	(D)	0	(D)	(D)	0	(D)
Aircraft and missiles	372,376	16,296	10,619	5,677	(D)	(D)	15	(D)	(D)	1,260
Professional and scientific instruments	38	13,458	4,499	8,958	(D)	(D)	735	1,077	66	1,011
Scientific and mechanical measuring instruments	381-82	8,135	4,416	3,719	(D)	(D)	262	357	24 (S)	333
Optical, surgical, photographic, and other instruments	384-87	5,323	84	5,240	(D)	(D)	473	720	42	678
Other manufacturing industries [1]	27,31,39	2,798	156	2,642	(D)	(D)	123	508	20	488

See explanatory information and SOURCE at end of table.

Table B-8. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1997

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
Distribution by industry:										
Nonmanufacturing		36,514	4,105	32,409	(D)	(D)	2,525	(D)	(D)	6,731
Transportation and utilities	40-42,44-49	3,013	200	2,812	161	0	161	(D)	(D)	(D)
Communications	48	(D)	(D)	1,884	(D)	0	(D)	(D)	0	(D)
Telephone communications	481	(D)	(D)	1,826	(D)	0	(D)	(D)	0	(D)
Other communications	482-484,489	58	0	58	(D)	0	(D)	(D)	0	(D)
Electric, gas, and sanitary services	49	(D)	(D)	258	(D)	0	(D)	(D)	(D)	(D)
Other transportation and utilities	40-42,44-47	(D)	(D)	670	(D)	0	(D)	(D)	0	(D)
Trade	50-59	(D)	(D)	7,961	(D)	(D)	933	(D)	(D)	1,995
Finance, insurance, and real estate	60-65,67	(D)	(D)	1,500	13	0	13	(D)	(D)	(D)
Services	701,72,73,75-81, 83,84,87,89	22,400	3,805	18,594	(D)	(D)	1,322	4,285	771	3,514
Business services	73	11,960	400	11,560	(D)	(D)	603	(D)	(D)	1,229
Computer and data processing services	737	11,706	389	11,318	(D)	15	(D)	1,331	131	1,200
Other business services	731-736,738	254	11	242	(D)	(D)	(D)	(D)	(D)	29
Health services	80	(D)	(D)	679	(D)	0	(D)	(D)	(D)	(D)
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	(D)	4	(D)	15	0	15	(D)	4	(D)
Other health services	802-805,808-809	49	(D)	(D)	(D)	0	(D)	(D)	(D)	(D)
Engineering and management services	87	9,290	3,381 (S)	5,909	(D)	(D)	695	2,621	628	1,993
Engineering, architectural, and surveying	871	2,039	1,258	781	(D)	(D)	(D)	(D)	(D)	(D)
Research, development, and testing	873	(D)	(D)	4,782	(D)	(D)	624	1,863	247	1,616
Other engineering and management services	872,874	(D)	(D)	347	(D)	(D)	(D)	(D)	(D)	(D)
Other services	701,72,75-79,81, 83,84,89	(D)	(D)	446	(D)	(D)	(D)	(D)	(D)	(D)
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	1,618	77	1,541	108	12	96	315	51	264

See explanatory information and SOURCE at end of table.

Table B-8. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1997

Industry and size of company	SIC code	Total			Basic research			Applied research		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]								
Distribution by size of company: [Number of employees]										
Total		157,539	23,928	133,611	8,623	1,173	7,450	25,597	1,822	23,775
Fewer than 500		24,063	2,209	21,854	2,438	337	2,101	6,144	704	5,440
500 to 999		4,966	376	4,590	(D)	(D)	372	1,116	98	1,018
1,000 to 4,999		19,590	540	19,049	1,756	37 (S)	1,719	3,682	98	3,584
5,000 to 9,999		14,266	612	13,655	(D)	(D)	421	(D)	(D)	2,792
10,000 to 24,999		21,510	913	20,597	(D)	(D)	2,039	(D)	(D)	4,474
25,000 or more		73,144	19,277	53,866	(D)	(D)	798	(D)	(D)	6,469

See explanatory information and SOURCE at end of table.

Table B-8. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1997

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
All Industries		95,542	13,795	81,747	27,777	7,139	20,638	18	30	15
Distribution by industry:										
Manufacturing		72,145	12,250	59,895	(D)	(D)	19,336	(D)	(D)	19
Food, kindred, and tobacco products	20,21	1,076	0	1,076	180	0	180	10	0	10
Textiles and apparel	22,23	(D)	(D)	364 (S)	45 (S)	0	45 (S)	(D)	(D)	9
Lumber, wood products, and furniture	24,25	275	0	275	(D)	0	(D)	(D)	(D)	(D)
Paper and allied products	26	(D)	(D)	307	(D)	(D)	962 (S)	67	100	66
Chemicals and allied products	28	(D)	(D)	9,151	(D)	(D)	2,830	15	0	15
Industrial chemicals	281-82,286	(D)	(D)	2,271	(D)	(D)	847	15	0	17
Drugs and medicines	283	(D)	(D)	5,711	(D)	(D)	1,737	(D)	(D)	15
Other chemicals	284-85,287-89	(D)	(D)	1,167	246	0	246	(D)	(D)	12
Petroleum refining and extraction	13,29	(D)	(D)	603	(D)	0	(D)	31	(D)	(D)
Rubber products	30	(D)	(D)	848	284	0	284	(D)	(D)	21
Stone, clay, and glass products	32	(D)	(D)	309	(D)	0	(D)	(D)	0	(D)
Primary metals	33	419	28 (S)	391	(D)	(D)	219	(D)	(D)	28
Ferrous metals and products	331-32,3398-99	294	28 (S)	266	(D)	(D)	(D)	42	87	(D)
Nonferrous metals and products	333-36	125	1	124	(D)	(D)	(D)	40	67	(D)
Fabricated metal products	34	(D)	(D)	775	(D)	(D)	589	(D)	(D)	35
Machinery	35	9,804	61	9,743	(D)	(D)	4,857	(D)	(D)	26
Office, computing, and accounting machines	357	(D)	(D)	6,089	3,963	0	3,963	31	0	31
Other machinery, except electrical	351-56,358-59	(D)	(D)	3,656	(D)	(D)	895	(D)	(D)	16
Electrical equipment	36	12,175	447	11,728	7,567	1,256	6,311	31	68	28
Radio and TV receiving equipment	365	(D)	(D)	112	(D)	0	(D)	1	(D)	(D)
Communication equipment	366	6,141	163	5,978	763	(D)	(D)	(D)	75	(D)
Electronic components	367	(D)	(D)	3,127	(D)	(D)	5,188	51	93	48
Other electrical equipment	361-64,369	2,778	266	2,512	(D)	(D)	871	(D)	(D)	20
Transportation equipment	37	25,517	8,880	16,637	2,978 (S)	2,025 (S)	953	9	17	5
Motor vehicles and motor vehicles equipment	371	(D)	(D)	12,941	36	(D)	(D)	(D)	1	(D)
Other transportation equipment	373-75,379	(D)	(D)	165	(D)	(D)	(D)	35	50	(D)
Aircraft and missiles	372,376	11,055	7,524	3,531	(D)	(D)	869	(D)	(D)	15
Professional and scientific instruments	38	(D)	(D)	5,858	(D)	(D)	1,354	(D)	(D)	15
Scientific and mechanical measuring instruments	381-82	(D)	(D)	2,382	(D)	(D)	740	(D)	(D)	20
Optical, surgical, photographic, and other instruments	384-87	(D)	(D)	3,474	614	0	614	12	0	12
Other manufacturing industries [1]	27,31,39	1,961	130	1,831	(D)	(D)	199	(D)	(D)	8

See explanatory information and SOURCE at end of table.

Table B-8. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1997

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
Distribution by industry:										
Nonmanufacturing		23,396	1,545	21,851	(D)	(D)	1,303	(D)	(D)	4
Transportation and utilities	40-41,44-49	(D)	(D)	1,541	(D)	(D)	(D)	(D)	(D)	(D)
Communications	48	(D)	(D)	1,174	0	0	0	(D)	(D)	0
Telephone communications	481	(D)	(D)	1,144	0	0	0	(D)	(D)	0
Other communications	482-484,489	30	0	30	0	0	0	0	0	0
Electric, gas, and sanitary services	49	(D)	(D)	151	(D)	(D)	30 (S)	12	18	12
Other transportation and utilities	40-42,44-47	(D)	(D)	216	(D)	(D)	(D)	26	96	(D)
Trade	50-59	(D)	(D)	4,951	82	0	82	(D)	(D)	1
Finance, insurance, and real estate	60-65,67	1,431	0	1,431	(D)	0	(D)	1	(D)	(D)
Services	701,72,73,75-81, 83,84,87,89	14,329	1,334	12,995	(D)	(D)	763	(D)	(D)	4
Business services	73	9,362	193	9,169	620	62 (S)	558	5	15	5
Computer and data processing services	737	9,154	182	8,972	(D)	62 (S)	(D)	(D)	16	(D)
Other business services	731-736,738	209	11	198	(D)	0	(D)	(D)	0	(D)
Health services	80	(D)	0	(D)	10	0	10	(D)	(D)	1
Offices and clinics of medical doctors, hospitals, medical and dental labs	801,806,807	(D)	0	(D)	0	0	0	(D)	0	(D)
Other health services	802-805,808-809	9	0	9	10	0	10	20	(D)	(D)
Engineering and management services	87	4,157	1,130	3,027	(D)	(D)	195	(D)	(D)	3
Engineering, architectural, and surveying	871	1,219	702	517	(D)	5	(D)	(D)	0	(D)
Research, development, and testing	873	(D)	(D)	2,362	(D)	(D)	180	21	60	4
Other engineering and management services	872,874	(D)	(D)	148	(D)	0	(D)	4	(D)	(D)
Other services	701,72,75-79,81, 83,84,89	(D)	11	(D)	0	0	0	(D)	(D)	0
Other nonmanufacturing industries [1]	07-12,14,15, 161-162,17	947	14	933	249	0	249	15	0	16

See explanatory information and SOURCE at end of table.

Table B-8. Funds for performance of basic research, applied research, development, funds not distributed, and percent of funds not distributed, by industry, size of company, and source of funds: 1997

Industry and size of company	SIC code	Development			Expenditures not distributed			Percent of expenditures not distributed		
		Total	Federal	Company	Total	Federal	Company	Total	Federal	Company
		[Dollars in millions]						[Percent]		
Distribution by size of company: [Number of employees]										
Total		95,542	13,795	81,747	27,777	7,139	20,638	18	30	15
Fewer than 500		14,281	1,124	13,157	1,200	45	1,155	5	2	5
500 to 999		3,016	194	2,822	(D)	(D)	378 (S)	(D)	(D)	8
1,000 to 4,999		12,449	352	12,097	1,703	53	1,650	9	10	9
5,000 to 9,999		9,011	312	8,699	1,832	89	1,743	13	15	13
10,000 to 24,999		11,642	526 (S)	11,116	(D)	(D)	2,969	(D)	(D)	14
25,000 or more		45,143	11,287	33,856	19,344	6,601	12,743	26	34	24

[1] Beginning in 1996, manufacturing companies with fewer than 50 employees and nonmanufacturing companies with fewer than 15 employees were sampled separately without regard to industry classification to minimize year-to-year variation in survey estimates. Estimates for manufacturing companies in this group are combined with those for companies in "Other manufacturing industries." Estimates for nonmanufacturing companies in this group are combined with those for companies in "Other nonmanufacturing industries." As a result, statistics for "Other manufacturing industries" and for "Other nonmanufacturing industries" after 1995 are not comparable with statistics for prior years.

KEY: (D) = Data have been withheld to avoid disclosing operations of individual companies.
(S) = Indicates imputation of more than 50 percent.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development: 1997

Comparability of Statistics

This section summarizes survey procedures and practices that may have affected the comparability of statistics produced from the Survey of Industrial Research and Development over time and with other statistical series.[10]

Revisions to Historical and Immediate Prior Year Statistics

Revisions to historical statistics usually have been made because of changes in the industry classification of companies caused, in turn, by changes in payroll composition detected when a new sample was drawn. Various methodologies have been adopted over the years to revise, or backcast, the data when revisions to historical statistics have become necessary. Documented revisions to the historical statistics from post-1967 surveys are summarized in NSF (1994). Detailed descriptions of the specific revisions made to the statistics from pre-1967 surveys are scarce, but U.S. Bureau of the Census (1995) summarizes some of the major revisions.

Changes to reported data can come from three sources: respondents, analysts involved in survey and statistical processing, and the industry reclassification process. Prior to 1995, routine revisions were made to prior year statistics based on information from all three sources. Consequently, results from the current-year survey were used not only to develop current-year statistics, but also to revise immediate prior year statistics. Beginning with the 1995 survey, this practice was discontinued. The reasons for discontinuation of this practice were annual sampling, continual strengthening of sampling methodology, and improvements in data verification, processing, and nonresponse follow-up. Moreover, it is not clear that respondents or those who processed the survey results had any better information a year after the data were first reported. Thus, it was determined that routinely revising published survey statistics increased the potential for error and often confused users of the statistics. Revisions are now made to historical and immediate prior-year statistics only if egregious errors are discovered.

Year-to-Year Changes

Comparability from year to year may be affected by new sample design, annual sample selection, and industry shifts.

Sample Design

By far the most profound influence on statistics from recent surveys occurred when the new sample design for the 1992 survey was introduced. Revisions to the 1991 statistics were dramatic (see *Research and Development in Industry: 1992* for a detailed discussion). While the allocation of the sample was changed somewhat, the sample designs used for the 1993–97 surveys were comparable to the 1992 sample design in terms of size and coverage.

Annual Sample Selection

With the introduction of annual sampling in 1992, more year-to-year change has resulted than when survey panels were used. There are two reasons why this is so. First, changes in classification of companies not surveyed were not reflected in the year-to-year movement. Prior to annual sampling, a wedging operation—which was performed when a new sample was selected—was a means of adjusting the data series to account for the changes in classification that occurred in the frame (see the discussion on wedging later). Second, yearly correlation of R&D data is lost when independent samples are drawn each year.

Industry Shifts

The industry classification of companies is redefined each year with the creation of the sampling frame. By redefining the frame, the sample reflects current distributions of companies by size and industry. A company may move from one industry to another due to either changes in its payroll composition, which is used to determine the industry classification code (see previous discussion under "Frame Creation"); changes in the industry classification system itself; or changes in the way the industry classification code is assigned or revised during survey processing.

[10] See also U.S. Bureau of the Census (1995).

A company's payroll composition can change because of the growth or decline of product or service lines, the merger of two or more companies, the acquisition of one company by another; divestitures; or the formation of conglomerates. Although an unlikely occurrence, a company's industry designation can be reclassified yearly with the introduction of annual sampling in 1992. The result is that a downward movement in R&D expenditures in one industry is balanced by an upward movement in another industry from one year to the next.

From time to time, the SIC coding system, which is used by most Federal agencies that publish industry statistics, is revised to reflect the changing composition of U.S. industry. For statistics developed for 1988–91 from the 1988–91 surveys, companies retained the industry classifications assigned for the 1987 sample. These classifications were based on the 1977 SIC system. The last major revision of the SIC system was in 1987. This new system has been used to classify companies in all of the post-1991 surveys.

The method used to classify firms during survey processing was revised slightly in 1992. Research has shown that the impact on individual industry estimates has been minor.[11] The current method used to classify firms was discussed previously under "Frame Creation." Methods used for past surveys are discussed in U.S. Bureau of the Census (1995).

Capturing Small and Nonmanufacturing R&D Performers[12]

Before the 1992 survey, the sample of firms surveyed was selected at irregular intervals.[13] In intervening years, a panel of the largest firms known to perform R&D was surveyed. For example, a sample of about 14,000 firms was selected for the 1987 survey. For the 1988–91 studies, about 1,700 of these firms were resurveyed annually; the other firms did not receive questionnaires, and their R&D data were estimated. This sample design was adequate during the survey's early years because R&D performance was concentrated in relatively few manufacturing industries. However, as more and more firms began entering the R&D arena, the old sample design proved increasingly deficient because it did not capture births of new R&D-performing firms. The entry of fledgling R&D performers into the marketplace was completely missed during panel years. Additionally, beginning in the early 1970s, the need for more detailed R&D information for nonmanufacturers was recognized. At that time, the broad industry classifications "miscellaneous business services" and "miscellaneous services" were added to the list of industry groups for which statistics were published. By 1975, about 3 percent of total R&D was performed by firms in nonmanufacturing industries.

During the mid-1980s, there was evidence that a significant amount of R&D was being conducted by an increasing number of nonmanufacturing firms; again, the number of industries used to develop the statistics for nonmanufacturers was increased. Consequently, since 1987 the annual reports in this series have included separate R&D estimates for firms in the communication, utility, engineering, architectural, research, development, testing, computer programming, and data processing service industries; hospitals; and medical labs. Approximately 9 percent of the estimated industrial R&D performance during 1987 was undertaken by nonmanufacturing firms.

After the list of industries for which statistics were published was expanded, it became clear that the sample design itself should be changed to reflect the widening population of R&D performers among firms in the nonmanufacturing industries[14] and small firms in all industries so as to account better for births of R&D-

[11] The effects of recent changes in the way companies are classified during survey processing are discussed in detail in U.S. Bureau of the Census (1994e and 1994a).

[12] See also NSF (1994, 1995, and 1996a).

[13] Until 1967, samples were selected every 5 years. Subsequent samples were selected for 1971, 1976, 1981, and 1987.

[14] For the 1992 survey, 25 new nonmanufacturing industry and industry groups were added to the sample frame: agricultural services (SIC 07); fishing, hunting, and trapping (09); wholesale trade–nondurables (51); stationery and office supply stores (5112); industrial and personal service paper (5113); groceries and related products (514); chemicals and allied products (516); miscellaneous nondurable goods (519); home furniture, furnishings, and equipment stores (57); radio, TV, consumer electronics, and music stores (573); eating and drinking places (581); miscellaneous retail (59); nonstore retailers (596); real estate (65); holding and other investment offices (67); hotels, rooming houses, camps, and other lodging places (70); automotive repair, services, and parking (75); miscellaneous repair services (76); amusement and recreation services (79); health services (80); offices and clinics of medical doctors (801); offices and clinics of other health practitioners (804); miscellaneous health and allied services not elsewhere classified (809); engineering, accounting, research, management, and related services (87); and management and public relations services (874).

industries so as to account better for births of R&D-performing firms and to produce more reliable statistics. Beginning with the 1992 survey, NSF decided to (1) draw new samples with broader coverage annually, and (2) increase the sample size to approximately 25,000 firms.[15] As a result of the sample redesign, for 1992 the reported nonmanufacturing share was and continues to be estimated at approximately 25 percent of total R&D.[16]

Time-Series Analyses

As discussed earlier, the statistics resulting from this survey are better indicators of changes in, rather than absolute levels of, R&D spending and personnel. Nevertheless, the statistics are often taken to be a continuous time series prepared using the same collection, processing, and tabulation methods. Such uniformity has not been the case. Since the survey was first fielded, improvements have been made to increase the reliability of the statistics and to make the survey results more useful. To that end, past practices have been changed and new procedures instituted. Preservation of the comparability of the statistics has, however, been an important consideration in making these improvements. Nonetheless, changes to survey definitions, the industry classification system, and the procedure used to assign industry codes to multi-establishment companies have had some, though not substantial, effects on the comparability of statistics.[17]

The aspect of the survey that had the greatest effect on comparability was the selection of samples at irregular intervals (i.e., 1967, 1971, 1976, 1981, 1987, and 1992) and the use of a subset or panel of the last sample drawn to develop statistics for intervening years. As discussed earlier, this practice introduced cyclical deterioration of the statistics. As compensation for this deterioration, periodic revisions were made to the statistics produced from the panels surveyed between sample years. Early in the survey's history, various methods were used to make these revisions.[18]After 1976 and until the 1992 advent of annual sampling, a linking procedure called wedging was used.[19] In wedging, the 2 sample years on each end of a series of estimates served as benchmarks in the algorithms used to adjust the estimates for the intervening years.

For a full discussion of the mathematical algorithm used for the wedging process that linked statistics from the 1992 survey with those from the 1987 survey, see U.S. Bureau of the Census (1994g). In general, wedging

> *takes full advantage of the fact that in the first year of a new panel [when a new sample is selected], both current-year and prior-year estimates are derived. Thus, two independent estimates exist for the prior year. The estimates from the new panel are treated as superior primarily because the new panel is based on updated classifications [the industry classifications in the prior panel are frozen] and is more fully representative of the current universe (the prior panel suffers from panel deterioration, especially a lack of birth updating). The limitations in the prior panel caused by these factors are naturally assumed to increase with time, so that in the revised series, we desire a gradual increase in the level or revision over time which culminates in the real difference observed between the two independent sample estimates of the prior year. At the same time, we desire that the annual movement of the original series be preserved to the degree possible in the revised series (U.S. Bureau of the Census, 1994).*

To that end, the wedging algorithm does not change estimates from sample years and adjusts estimates from panel years, recognizing that deterioration of the panel is progressive over time. One of the primary reasons for deciding to select a new sample annually rather than at irregular intervals was to avoid applying global revision processes such as wedging. Consequently, the 1992 survey was intended to be the last one affected by the wedging procedure.

Comparisons to Other Statistical Series

NSF collects data on federally financed R&D from both Federal funding agencies—using the Survey of Federal Funds for Research and Development—and

[15] Annual sampling also remedies the cyclical deterioration of the statistics that results from changes in a company's payroll composition because of product line and corporate structural changes.

[16] See also NSF (1997a and 1998a).

[17] For discussions of each of these changes, see U.S. Bureau of the Census (1994g); for considerations of comparability, see U.S. Bureau of the Census (1994e and 1993).

[18] See U.S. Bureau of the Census (1995).

[19] The process was dubbed wedging because of the wedgelike area produced on a graph that compares originally reported statistics with the revised statistics that result after linking.

performers of the work, industry, Federal labs, universities, and other nonprofit organizations—using the Survey of Industrial Research and Development and other surveys. As reported by Federal agencies, NSF publishes data on Federal R&D budget authority and outlays, in addition to Federal obligations. These terms are defined below:[20]

- *Budget authority* is the primary source of legal authorization to enter into financial obligations that will result in outlays. Budget authority most commonly is granted in the form of appropriations laws enacted by Congress with the approval of the president (NSF 1998b).

- *Obligations* represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when the funds were appropriated or when future payment of money is required.

- *Outlays* represent the amounts for checks issued and cash payments made during a given period, regardless of when the funds were appropriated or obligated.

National R&D expenditure totals in NSF's *National Patterns of R&D Resources* report series are primarily constructed with data reported by performers and include estimates of Federal R&D funding to these sectors. But until performer-reported survey data on Federal R&D expenditures are available from industry and academia, data collected from the Federal agency funders of R&D are used to project R&D performance. When survey data from the performers subsequently are tabulated, as they are in this report, these statistics replace the projections based on funder expectations. Historically, the two survey systems have tracked fairly closely. For example, in 1980, performers reported using $29.5 billion in Federal R&D funding, and Federal agencies reported total R&D funding between $29.2 billion in outlays and $29.8 billion in obligations (NSF 1996b). In recent years, however, the two series have diverged considerably. The difference in the Federal R&D totals appears to be concentrated in funding of industry, primarily aircraft and missile firms, by the Department of Defense. Overall, industrial firms have reported significant declines in Federal R&D support since 1990 (see table A-1), while Federal agencies have reported level or slightly increased funding of industrial R&D (NSF 1996b). NSF is examining the causal factors behind these divergent trends.

[20] See also NSF (1997b).

Survey Definitions

R&D Funds per R&D Scientist or Engineer

All expenditures associated with the performance of industrial R&D (salaries, wages, and fringe benefits paid to R&D scientists and engineers; materials and supplies used for R&D; depreciation on capital equipment and facilities used for R&D; and any other R&D costs) divided by the number of R&D scientists and engineers employed. To obtain a per person expenditures on R&D for a given year, the total R&D expenditures of that year are divided by an approximation of the number of full-time-equivalent (FTE) scientists and engineers engaged in the performance of R&D for that year. For accuracy, this approximation is the mean of the numbers of such FTE R&D-performing scientists and engineers as reported in January for the year in question and the subsequent year. For example, the mean of the numbers of FTE R&D scientists and engineers in January 1996 and January 1997 is divided into total 1996 R&D expenditures for a total cost per R&D scientist or engineer in 1996.

Employment, FTE R&D Scientists and Engineers

People employed by the company during the January following the survey year who are engaged in scientific or engineering work at a level that requires knowledge of engineering or of the physical, biological, mathematical, statistical, or computer sciences equivalent at least to that acquired through completion of a 4-year college program with a major in one of those fields. FTE employment is the number of scientists and engineers in the company who are assigned full time plus a prorated number of employees working part time on R&D.

Employment, Total

Number of people domestically employed by R&D-performing companies in all activities during the pay period that includes the 12th of March, the date most employers use when paying first quarter employment taxes to the Internal Revenue Service.

Federally Funded R&D Centers (FFRDCs)

R&D-performing organizations administered by industrial, educational, or other institutions on a nonprofit basis, and exclusively or substantially financed by the Federal Government. R&D expenditures of industry-administered FFRDCs are included with the Federal R&D data of the industry classification of each of the administering firms. The industry-administered FFRDCs included in the 1997 survey are listed below.

FFRDCs Supported by the Department of Energy

Energy Technology Engineering Center,
Rockwell International Corp.,
Canoga Park, CA

Idaho National Engineering Laboratory,
Lockheed Martin Corp.,
Idaho Falls, ID

Oak Ridge National Laboratory,
Lockheed Martin Corp.,
Oak Ridge, TN

Sandia National Laboratories, Lockheed Martin Corp.,
Albuquerque, NM

Savannah River Laboratory,
Westinghouse Corp.,
Aiken, SC

FFRDC Supported by the Department of Health and Human Services, National Institutes of Health

National Cancer Institute (NCI) Frederick Cancer Research Facility
Science Applications International Corporation
Advanced Bioscience Laboratories, Inc., Frederick, MD

Funds for R&D, Company and Other

The cost of R&D actually performed within the company and funded by the company itself or by other non-federal sources, not including the cost of R&D supported by companies but contracted to outside organizations such as research institutions, universities and colleges, nonprofit organizations, or—to avoid double-counting—other companies.

Funds for R&D, Federal

Receipts for R&D performed by the company under Federal R&D contracts or subcontracts and R&D portions of Federal procurement contracts and subcontracts.

Funds for R&D, Total

Operating expenses incurred by a company in conducting R&D in its own laboratories or in other company-owned or -operated facilities. These expenses include wages and salaries; materials and supplies; property and other taxes; maintenance and repairs; depreciation; and an appropriate share of overhead, not including capital expenditures.

Industrial R&D

As used in this survey, R&D is the pursuit of a planned search for new knowledge or understanding of the subject under study. This search may have reference to a specific application (basic research); the acquisition of knowledge or understanding to meet a specific, recognized need (applied research); or the application of existing knowledge or understanding toward the improvement of a present product or process (development). In industry, *basic research* is the pursuit of new scientific knowledge or understanding that does not have specific immediate commercial objectives, although it may be in fields of present or potential commercial interest; *applied research* is investigation toward discovering new scientific knowledge that has specific commercial objectives with respect to products, processes, or services; and *development* is the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes. The survey covers industrial R&D performed by people trained—either formally or by experience—in engineering or in the physical, biological, mathematical, statistical, or computer sciences and employed by a publicly or privately owned firm engaged in for-profit activity in the United States. Specifically excluded from the survey are quality control, routine product testing, market research, sales promotion, sales service, and other nontechnological activities; routine technical services; and research in the social sciences or psychology.

Net Sales and Receipts

Dollar values for goods sold or services rendered by R&D-performing companies to customers outside the company—including the Federal Government—less such items as returns, allowances, freight, charges, and excise taxes. Domestic intracompany transfers and sales by foreign subsidiaries are excluded, but transfers to foreign subsidiaries and export sales to foreign companies are included.

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